UNIVERSITY OF BIRMINGHAM

School of Computer Science

Introduction to Human Computer Interaction
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"Queue Application"

Group 2

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Definition of the Problem

It is very important to understand the problem of waiting in queues in our everyday life and the ways of solving this problem. In our life people are wasting time in queues almost every day, for instance at the train station when buying a ticket, at the bank, at the hospital, the airport, at theme parks such as Disneyland, at school when getting ID Cards or when trying to get some documents at the library and school registration days.

Nowadays there are two different kinds of queues. The First is the queue where people stay and wait till their own turn. In the other type of queue one takes a number ticket as his order which allows him to leave the place of the queue and do some other kind of business of his own during that time.

Obviously, the first kind, which is called an unstructured queue, is the most conventional one and seems like a waste of time. But it depends on how many people are in the queue. If there are no more than 10 people in a queue, the time spent for waiting is acceptable. But, if there are too many people in a queue, staying and waiting there for one's own turn is not a good choice.

To solve the problem arising from the first method, the second kind – a structured queue - was invented, which allows people to take a number ticket as their order in the queue when they join it. Therefore there is no need for them to wait in the queue all the time for their turn. During this period they have an opportunity to spend their free time for some other things around the place which is not far from the queue. However, in this solution a problem is detected also. This problem is that people are not able to correctly estimate the time that they need to return to the queue.

So, we need to work out a formula which allows us to reduce the time spent on waiting and solve the problem of many people standing and wasting their time in queues. Therefore, the main problem in the queue is waiting. People do not know how long they are going to wait in the queue. Some queues have a certain structure but some of them are unstructured. People need to use an application before they go to queue as they can manage their time with a useful application. Although there are some queue management systems, there is no fully practical queue application in the world.

Key problems

- Disputes over the order of the queue
- The queue becomes scrambled
- Unknown period of time waiting in a queue
- Loss of time

Review of Queue Application

A queue is a line of persons waiting in turn to be served. People collectively spend a lot of time waiting in queue. Waiting in queue is punctuated by trouble, anger and sometimes fights between the people in the queue. People waste hours of their lives when they are waiting in queue. Some existing queue systems do not have an organized structure in place, for instance at university admissions offices or train stations. Waiting in queues and service systems are important parts of the business world. Although losing time in queues, people must stand there because there is no other alternative solution. On the other hand, there are some organized systems, for instance at banks, or concerts. Banks use some systems nowadays but these are not intelligent systems: The customer goes to the bank, takes a queue number and waits in queue. This system is more common nowadays but customers do not know how long he or she needs to wait. The Bank line system seems good but in reality it is weak.

This queue application research will show customers how to use a new queue application system and will explain how it works. It will show the techniques and methodologies. It can be used by all people simply and freely. Everyone can download the application from an application store and use it. For example, if one of the University students wants to see an administrative officer but there are many students at the university, she must wait long time. This may not be possible because she has an important lecture. However, there will be an electronic meter with Wi-Fi at the administration office. The student can use her application from her iPhone. She can open her application and she can select the university section and find her university. From here she can find the required department, select the administration office and see how many people are waiting in queue and when she can find an available place there. She can decide whether she will wait and will receive a number and an approximate queuing time. When the administration officer receives people, she will see her updated estimated time on her iPhone queue application, for instance “your estimated wait time is now 30 minutes and you are now second in line.” By using the application, she will not waste time in a queue.

Tam, J. (2014)

Literature review

Queueing problem

The most common problem for the customer in the service industry is waiting, because the limited counter cannot meet the requirements of the increasing number of customers. So waiting in line, also known as queueing, is necessary. A queue is a line of people waiting in turn to be served for different purposes. People collectively spend a lot of time waiting in queues. Filiatrault (1993) suggests that "waiting lines imply both economic and psychological costs for the consumer, both of which increase the real global costs incurred by consumers." Waiting in queues is often punctuated by trouble, anger and sometimes fights. However, psychological costs cannot be assessed correctly in a simple way (Filiatrault ,1993). Generally, the longer time the customer spends on waiting, the more unstable their emotional state becomes, as tension stress increases, and even anger rises (Filiatrault ,1993). People waste a lot of time when they are waiting in queue. Some existing organizations or departments do not have organized systems, for instance university admission offices or train stations. Waiting queues and service systems are important parts of the business world. Although losing time in queues, people must stand there because there is no alternative way to find a solution.

Typically modern queue models are implemented in two different ways, one is the traditional queue usually generated in front of counters. This occurs because serving each customer requires a certain amount of time, and usually one customer will need to be served, for instance, at the counter of the store, but other situations may exist, where one customer buys many things.

This means that the serving time could be longer than the average, and that things happen that can increase the waiting time for the people who are in the same queue. Other people who want to be served should stay in the queue and wait their turn. Eventually this may lead to dissatisfaction in customers, especially psychologically. The queue not only affects people in a psychological aspect, but also in other aspects, such as people may miss other important events or works whilst in the process of waiting.

The weakness of this model can be summarized in following points. Firstly, to stay in a long queue for service seems like it is too time-consuming. The customer can either stay in the queue and wait their turn if they want to be served, or they can exit the queue which means they do not want to be served. Secondly, once the customer leaves the queue for some reason they cannot go back to the same position in that queue, and they need to join the end of the queue which means waiting even longer, if they want to be served. Although waiting in a queue is very time consuming and can be irritating, nowadays' people's behavior and attitudes have adapted very well toward the queueing culture. It is not rare to see a famous place flooded with people staying in a queue and waiting to get inside. According to Mann (2014), there is a growth of people who would even wait for tickets overnight just for a football game, and as a result of the increased demand comes the middlemen who profit by undertaking their own ticket buying service. This leads to another interesting question: how can queueing benefit other people?

Long queues: Consumers were eager to get their hands on Apple's new iPhone in Glasgow's Buchanan Street.© HMEDIA / SWNS Group

The second model of a queue is different from the traditional queue, there are some organizations or departments in the world that are more organized, for instance some banks and Government institutions. Banks have started to use some new systems, but these are not always intelligent. Customers who go to the bank take a queue number and wait in line. This system is becoming more common but customers do not know how long he or she needs to wait. The bank line system is a better solution but it still has its weaknesses. The key point of this model is the index number system that it introduced. Customers who want to join the queue need to pick up an index number, which indicates the position of this customer in this queue, before they join the queue. The basic concept of this model is that there is no need for the customer to stay in the queue all the time. The person can just take an index number and find a place to sit down and have a cup of coffee, instead of standing in the queue feeling bored and doing nothing. The advance index number system can print a number which indicates how many people are before you in the queue. However, the weakness of this model has also emerged. The customers cannot know how long they need to wait, and if they go somewhere to do some other work in that time, they cannot estimate appropriately when they need to return. According to Kumar (1997), customers will have a high satisfaction if the service time is less than they expected, but on the other hand, customers will have an even higher dissatisfaction if the service time is longer than they expected. The satisfaction rates are different between people who acknowledge the waiting time and people who have no idea how long they are going to wait. Therefore it is necessary to let the customer know how much time they need to wait, and more importantly, the time has to be exact.

This queue application research will demonstrate how to use a new queue application, and will explain how it will work. It will show the techniques and methodologies. It can be used by all people simply and freely. Everyone can download that application from an application store then use it. For example, if one of the students from the University wants to see an administrative officer but there is a long queue and she must wait a long time, which would mean that she misses an important lecture, she can use an electronic meter at the administration office. It will be an online system that the student can access via her application on her smart phone. She can open her application and choose the university part then she can find her university, and she can find her department in school in order to find the administration office waiting status online. This allows her to see how many people are waiting in line and when she can find an available place. She can then decide to get a number and will receive an approximate waiting time. When the administration officer receives people, she will see an updated estimated time on her smart phone queue application, for instance “your estimated waiting time is 30 minutes and there are three students ahead of you”. In this way, she will not waste time in a queue.

Queue Management System

Strengths of this system

A Queue Management System needs to be reasonable and understandable. When a customer uses the system for the first time, it should be very clear. In Figure 1 there are 2 main buttons. They are very big, simple and readable for almost everyone. It is shown that a customer should choose a service – “Please Select Your Service”. A customer chooses a service and receives a ticket by pressing the button on the ticket printer which is shown in Figure 2. It also has the label and the big blue arrow that displays where it should be pressed. A customer presses the button and receives a ticket with his/her waiting time shown. The ticket which is displayed in Figure 3 has information about the time and date that the ticket has been taken, a queue number, queue length and an average waiting time in minutes. The main thing here is that it shows the current queue length and average time. This is an advantage for customers to know how much time he/she should wait until his/her turn to be served. While a customer waits, the huge screen (Figure 4) displays ticket numbers, orders and desk numbers etc. The key point here is that when it is time for a customer’s turn to be served, the screen will show the service name, ticket number and desk number of this customer. Therefore a customer will know that it is his/her turn to go to particular desk.

Figure 1. *Touch Screen for Ticket Issue*

This is the Ctrontx Queue Management System which is presented for customers to use for choosing their service and getting a ticket. Once a customer takes a ticket from this kind of machine, he/she waits their turn to be served.

Figure 2. Ticket printer

Figure 3. Ticket

Figure 4. LCD display

Weaknesses of this system

The main weakness of this Queue Management System is that it is not interactive. For instance, when a customer gets a ticket by pressing the print button it shows an average wait time. However, if the time is more than 15-20 minutes then it is possible that a customer wouldn't like to wait this much time in the office and wants to use the time efficiently to do other things whilst waiting in the office. Nevertheless in case the waiting time is more than 20 minutes and the queue length is 6 and a customer doesn't want to spend this specific time waiting, the timing is not interactive – it will not update the queuing time. It means that the waiting time of other customers could fall, but they would not be informed. Therefore the customer could miss his/her turn. When he/she comes back and see that his/her turn has gone, they would have to get a new ticket number to be served, which makes the addition of the system completely useless.

Results of literature review

This shows that people can use this system easily and easily integrate it into their life. The Queue application can be user friendly in people's life and they can manage it at day time. We decided to create this application so that people will be able to join queues instantly. Queue management systems are not interactive with time for instance in banks and hospitals etc.

Kieran Walpole

Background

Age : 20
Occupation: Student
University : Birmingham

Main Points

- Wants easy way to manage his time.
- Using smart phone applications every day
- Does not want to waste time in queue
- Need to manage his time well

Goals

- To manage his time well and minimize waiting time in queue
- Use technology conveniently

"I just want to feel comfortable and relax in queue"

Description

Kieran is an 18 year old undergraduate student from Birmingham, UK. He is registered to the University of Birmingham to study English. His parents believe that he has an opportunity to improve his skills, whilst studying at a prestigious university.

He is a first year student.

His parents believe that he has to use his time efficiently in the university. He does not want to waste his time and he wants to get a useful smart phone queue application which he can use to check available times of departments at university. The Queue application is the only way to check department's available times for him. He can manage his time with it.

Scenarios

Kieran wants to collect his ID card at the beginning of the semester. He does not have much time to spare. He can go wherever he wants with his ID card at the university, without it he cannot use the printers or other amenities.

He needs to create a new bank account in the city where he studies. He wants to go there with his father but his father is older and does not want to wait there very long because he has other jobs to do.

He wants to get an appointment in a hospital but he knows that there are many people there and he feels bad when he meets with ill people because he worries about them. He just needs to get an appointment and see a doctor right away.

Pain Points

- Waiting in long queues
- Cannot manage time
- Cannot guess how much time you need to spend in a queue

Can Ozonur

Background

Age : 34
Occupation: Electrical Maintenance Chief

Main Points

- Is very hard working , he has important responsibilities
- Has less time and he wants to manage his time well
- Likes to use technology, so is familiar with new smart phone applications

Goals

- To minimize waiting time in queue when he goes to somewhere
- Spend as little time as possible in queue

"I just want to do some other things when I am in a queue"

Description

Can has been working in an oil refining company for 5 years, and he worked in Qatar so he has strong international experience.

Since he is involved in the Electrical Maintenance Department in the company, he has experience of using very a variety of applications, particularly the very popular mobile application. Besides, He has a high-end smartphone.

He is very busy processing business and has only a few hours of free time. When he has got the number and joined a queue, he will always use this time to do something else. Therefore, he regularly misses his number and has to re-queue. He would be happy to use the phone to remind him of the remaining waiting time.

Scenarios

He should get a loan from the bank to buy a house but he does not want to wait in queue. He is a busy man. He is busy working hard in the day time. He just needs to go to a bank and needs to give the required documents to a customer representative who works at the bank.

He had an appointment at the hospital but when he arrived at the hospital there were still a lot of people waiting in line. He cannot wait in queue because he is too sick and he wants to see doctor as soon as possible.

He wants to post a parcel to his partner at the post office but he does not have much time to wait, he just needs to go and leave a parcel there. He knows many people use the post office and he is under pressure for time.

Pain Points

- Waiting in long queues
- Queuing time is too long and disrupts time schedules
- Cannot estimate queuing time correctly, may need to rejoin a queue

Robert Smith

Background

Age : 72
Occupation: retired engineer
University : BEng and MEng in Chemical Engineering in Edinburgh University

Main Points

- Wants an easy way to manage his time.
- Using smart phone applications every day
- Does not want to waste time in queue
- Needs to manage his time well

Goals

- Remain anxiety and stress-free
- Use peculiar smartphone apps in as short a time as possible
- Wants to deal with people rather than machines
- Spend less time in queues to avoid tiredness

"I just want to feel comfortable and relax in queue"

Description

Robert is a 72 years old pensioner. He came to the University of Edinburgh to study chemical engineering for his bachelor degree. He graduated and did his masters in the same university. Robert worked for many companies and factories. He married with a UK citizen and lives in Edinburgh. Robert has 3 children but all of them are married and live separately from their parents. Robert is not dependent on his children. Therefore he does everything by himself.

Scenarios

He wants to buy a present for his grandchild Lucy for her birthday. To buy a gift he needs to get some money and go to a gift store to buy one, because he is not able to deal with ATMs and again wait in a queue. Also Robert doesn't want to spend any more time in bank. The main objective is to withdraw money to buy a present and spend it on different occasions.

Robert and his wife Anna go to the big supermarket a little way from their house. They buy different food from this store, however at the end of the shopping they are faced with long queues in the supermarket. They are elderly and they cannot wait for a long of time in a queue. Robert wants to check out as quickly as possible and to continue his gardening.

Robert buys gifts and should go to the post office to pack them and send them. There are always many people in post offices and long queues. He doesn't want to spend his time waiting in a long queue. The process should be comfortable for him because he doesn't want to tire too much.

Pain Points

It is really hard for him to wait in long queues for a long time period. He has some illnesses and as he is more than 70 so waiting in a long queue on feet can have bad effects on Robert's health. Also he has poor eyesight and cannot deal with smartphones and other devices as easily and quickly. He doesn't have the patience to spend more time with apps and programs on a phone, although he has a smartphone. He just uses it to talk to his relatives and friends.

First Generation Prototype

OVERVIEW

First generation prototypes are very important to evaluate and obtain better results of the real application. Three different prototypes are presented. There are many advantages of creating and evaluating through prototypes. It is an easy way to get the application close to the real version and to evaluate the pros and cons in every prototype. Minimal time is used to create prototypes. However evaluation is a crucial part of this work.

We made these prototypes to analyze user behaviors whilst they use the application. There are detailed descriptions of each prototype. Nielson's ten usability heuristics have been used to get a better understanding of the strengths and weaknesses of the prototypes. At the end of the evaluation of each individual prototype we established the user's perspective when using the application.

According to Nielsen's heuristics, all usability issues should be given a severity rating in order to find out which is the most critical problem that needs to be solved at this stage. With Nielsen's severity ratings, each part of the heuristics ratings can be shown clearly, and then can be improved in the next generation prototype. This paper will not only use this severity rating for the heuristics part, but also for ratings in the personas part. Nielsen's severity ratings are showed below:

Severity Rating	Meaning
0	I don't agree that this is a usability problem at all.
1	Cosmetic problem only: does not need not be fixed unless extra time is available on project.
2	Minor usability problem: fixing this should be given low priority
3	Major usability problem: important to fix, so should be given high priority
4	Usability catastrophe: imperative to fix this before product can be released

PROTOTYPE 1

Description of prototype

Tool used: Mockup

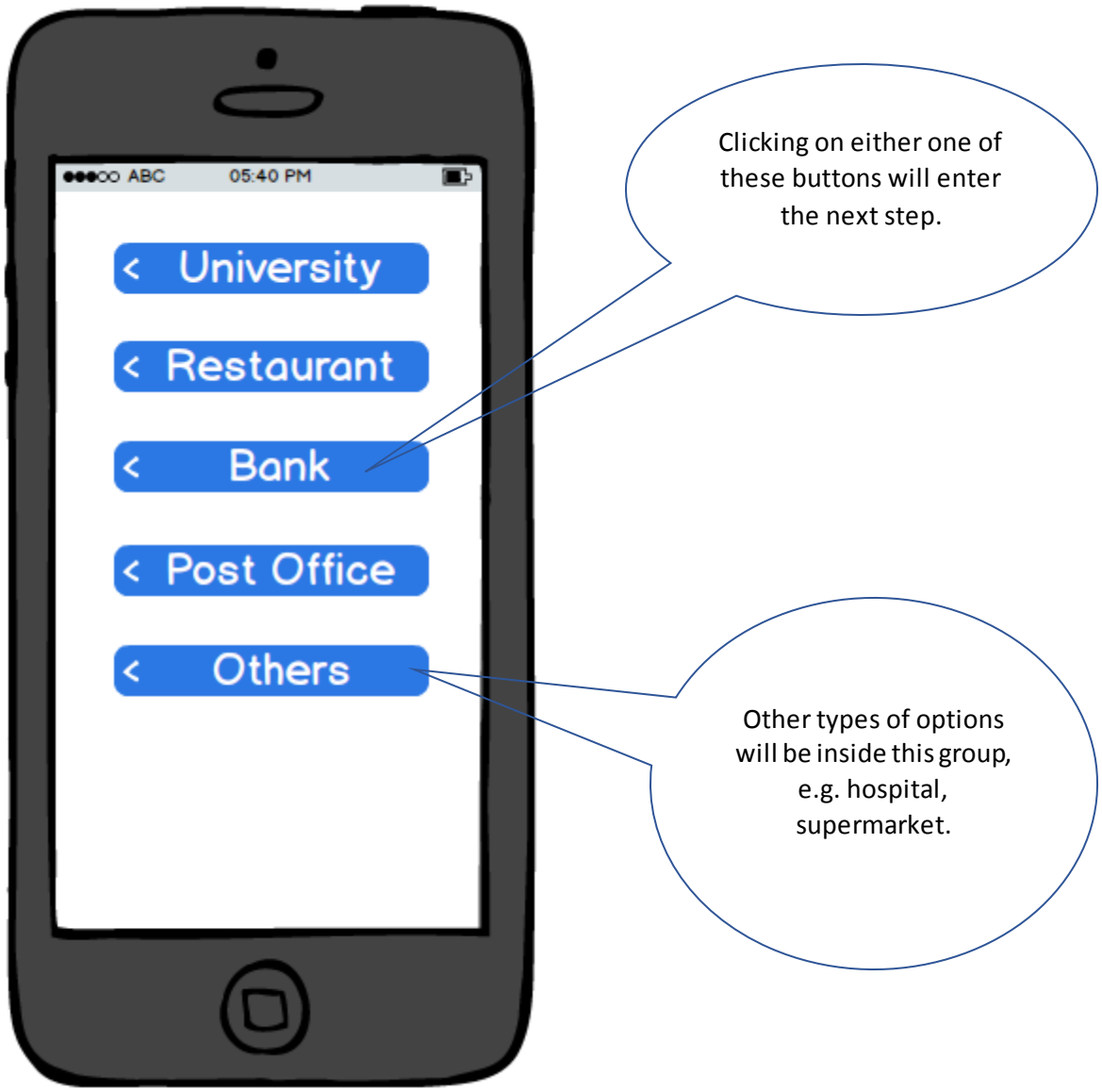
Primary target: Create an application for people to make reservations easily.

Rationale

The target users of this prototype are those who want to make reservations far away from the destination or cannot arrive at the destination in short period of time. Therefore this prototype will focus the reservation procedure.

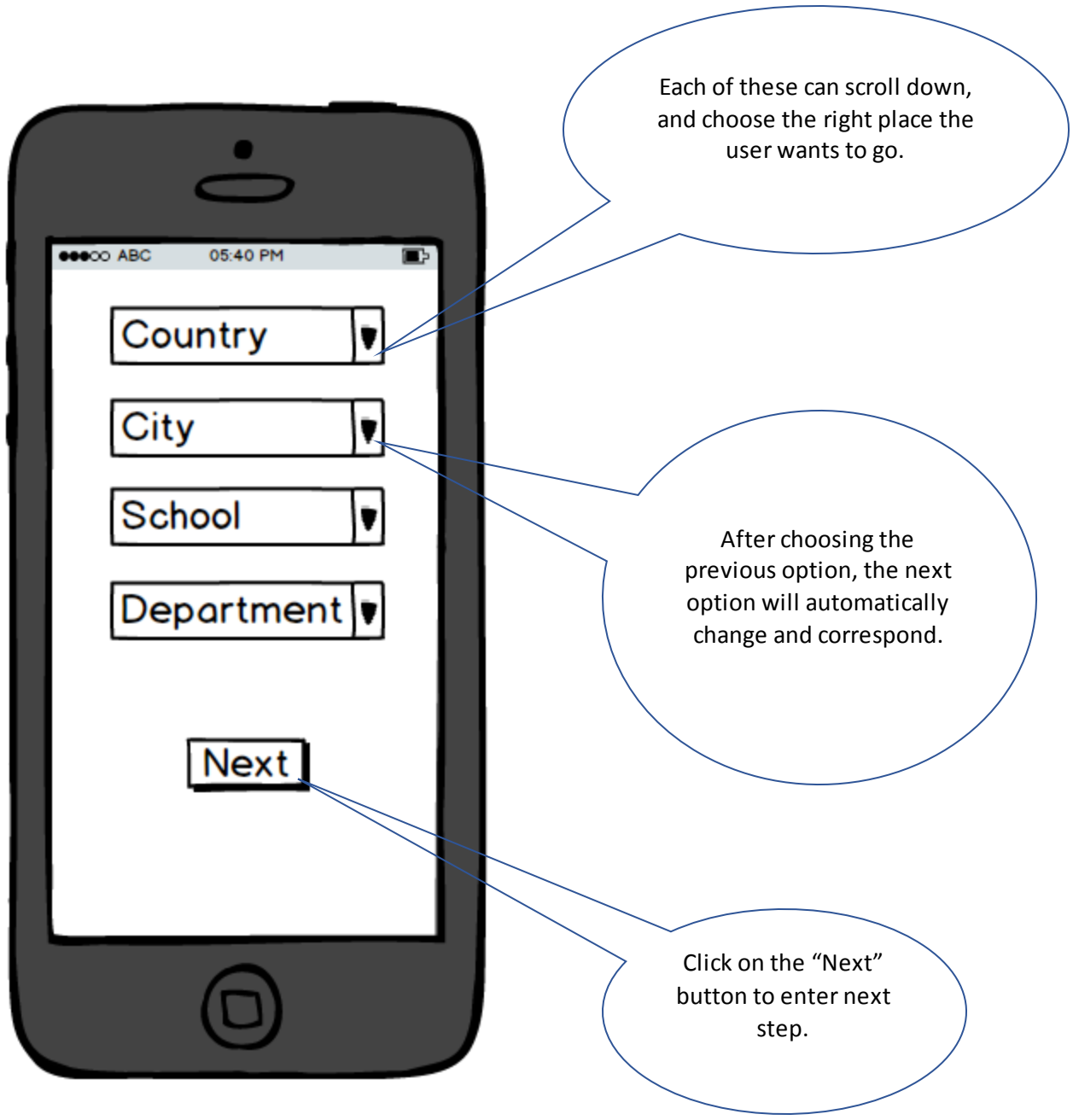
Screen 1

Enter the main screen, and choose where the user wants to make a reservation at. It will show the most commonly used places, and all other choices are in the “Other” button.



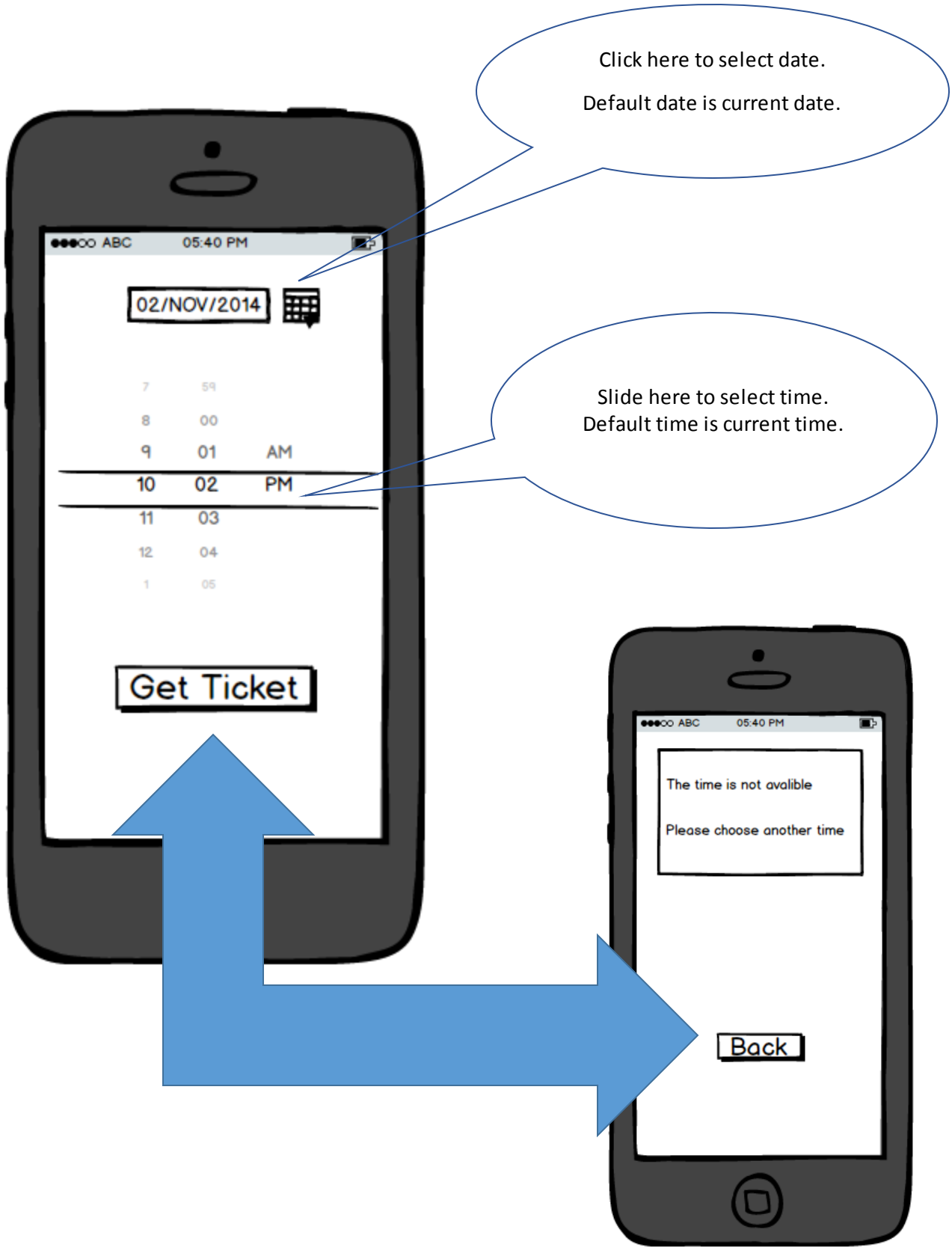
Screen 2

After choosing an option, for example, university, the user enters Screen 2, and he/she has to choose which university they require, by entering the university name, and the name of the department they require, and click "Next" button.



Screen 3

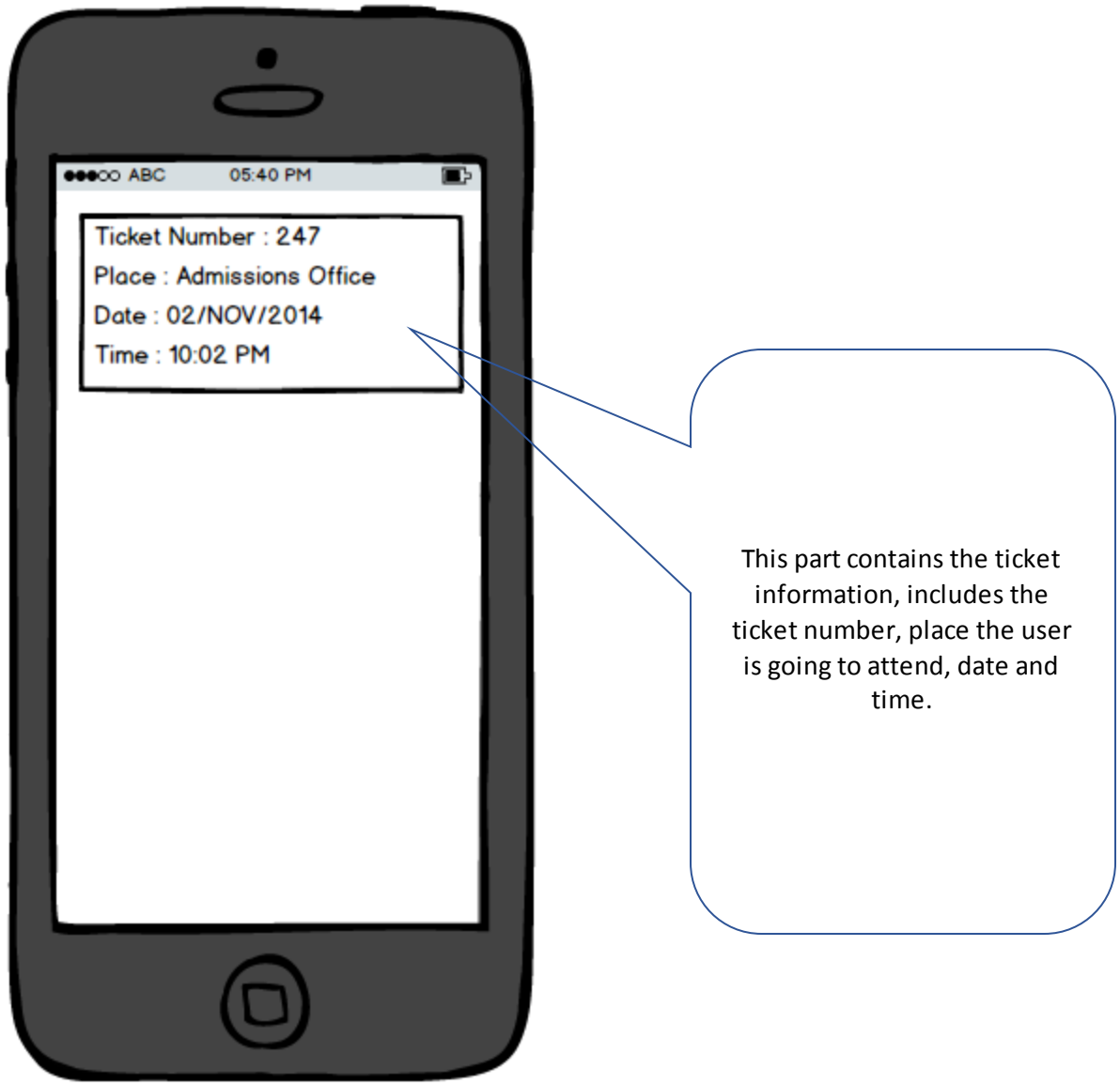
After confirming the location, the user enters the screen for selecting the time for their reservation.



After confirmation of the time and date, press the button ”Get Ticket”, and if the time is not available, the system will pop out a screen and inform the user, and the user can click the button “Back” to return to the previous screen to reschedule.

Screen 4

If the time is available, the user gets a ticket in his/her phone. Then the user just needs to bring his/her phone and be there on time.



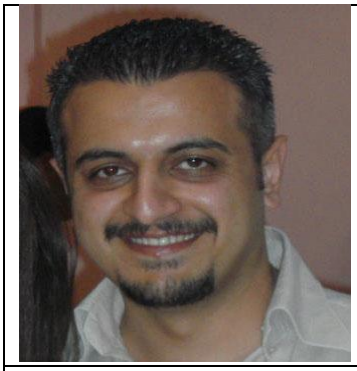
Evaluation of prototype

Nielsen Heuristics for first prototype			
№	Criteria	Rating	Discussion / ways to solve
1	Visibility of system status	0	The step by step procedure provides clear information, including the ticket number, place, date, time.
2	Match between the system and the real world	1	Whole system is in English. Although English is a worldwide language, there are still a lot of people who do not speak in English. But queuing on the other hand, its population is way beyond the number of people who speak English. Therefore this system needs a function to change it in to different languages.
		3	The procedure of making a reservation with this system might take more time than using the phone. The solution is to simplify the process.
3	User control and freedom	4	Although there is a “next” and “back” button, but it is impossible for the user to take a step back or quit the procedure. Add a “back” button on screen 2 and 3, and a “quit” button on the ticket (Screen 4) should solve the problem.
4	Consistency and standards	N/A	
5	Error prevention	2	Before getting the ticket, there should be a confirm page with the information on it, to make sure the user does not make a reservation at a wrong place and/or the wrong time.
6	Recognition rather than recall	2	Font is relatively small and low contrast. The information on screen 3 and 4 should be enlarged for a better contrast.
7	Flexibility and efficiency of use	4	The efficiency of making reservations. This system needs the user to provide a lot of information for making a reservation, it is too time consuming. The system should add another function that can locate where the user is or add a “favorite” to reduce and simplify the procedure.
8	Aesthetic and minimalist design	2	The user interface is just plain white. The interface has not been well designed; it should contain at least some color. It will be improved and it will be more innovative.
9	Help users recognize, diagnose, and recover from errors	4	Same as No. 3, and the user can only find out they’ve made a mistake after receiving the ticket. Same solution, add a “back” button on screen 2 and 3, and a “quit” button on the ticket (Screen 4) and add a confirm page same as No. 5.
10	Help and documentation	3	There is no user’s manual and no information for how to use this system. The system should add a help or support function before the screen 1 in the main menu to guide the user.

Student

	**Scenario**	**Reason**
Scenario 1	*Wants to collect his ID Card from University Admission Office.*	• He is a new student and he does not have an ID card to go the Library, otherwise he cannot go to study without student ID card. He is familiar with new technology so he can get a new queue application to get appointment. This prototype is useful for him, but he spends more time to control all steps and he feels this is time-consuming.
Scenario 2	*Wants to create new bank account to manage his budget*	• Although he is familiar with new technology he does not like this prototype because he wants to get a queue number quickly. There are some extra steps on the application, he needs more functionality.
Scenario 3	*Wants to send a parcel to his friend in Germany.*	• He checks the availability of the post office at the region where he lives and he finds the post office which is nearest to him. However, he sends his parcel to his friend in a fast way. Some screens are not useful for him, he normally uses a private company to send his packages but this time he uses a post office to send a parcel.

Businessman

	**Scenario**	**Reason**
Scenario 1	*Wants to get a loan from bank to buy a house*	• He wants to get a loan from bank, and this business can only be solved in the counter. So he has to join the queue. But he considers that the procedure of joining the queue takes much more time than he expected. Because there are many entries that need to be set. However, this application can join the queue remotely, which means he can join the queue before he come to the bank.
Scenario 2	*Does not want to stay in the queue for waiting to meet doctor*	• Engaged in the work related to science and technology, he is very familiar with the use of new technology. But he does not want to stay in the queue because it is waste of time. He can use this period of time to do other things. Thus, he joins a line by using queue application, and then he can leave the queue as long as the returns in the specified time. But he still needs to spend some time to set the entries before join the queue.
Scenario 3	*Wants to post a parcel to his partner*	• He checks the availability of the post office at the region near his office. However, he sends his parcel to his partner with fast way. Some sets are not necessary for him. Using this application can reduce the time of staying in the queue. The price is that he needs to spend a little bit of time to set it up.

Elderly person

	Scenario	Reason
Scenario 1	*Withdraw some money from his pension bank account.*	• Robert uses 1st prototype application to not wait in a queue in the bank. He wants to withdraw some money as quickly as possible. When he launches the app the first page occurs. Then he chooses “bank”. It is clearly shown the points of app. However after the 2nd page, next pages are not readable for Robert. It is difficult to interact with such an app without straining his eyesight.
Scenario 2	*Shopping from supermarket*	• When he utilizes the application to get a ticket number for a queue he needs to go over all the steps of the app. This is not efficient for an elderly person to do this just to get a ticket. It should be easier to receive a ticket from the app. There should be fewer steps for receiving a ticket.
Scenario 3	*Send a parcel to his son who lives in California.*	• Robert knows that there are always queues in the post offices. Therefore it is a good application not to wait in a long queue but get a ticket beforehand. Nevertheless it is complicated for elderly person to figure out what he supposed to do for this purpose.

PROTOTYPE 2

Description of prototype

Tool used: Mockup

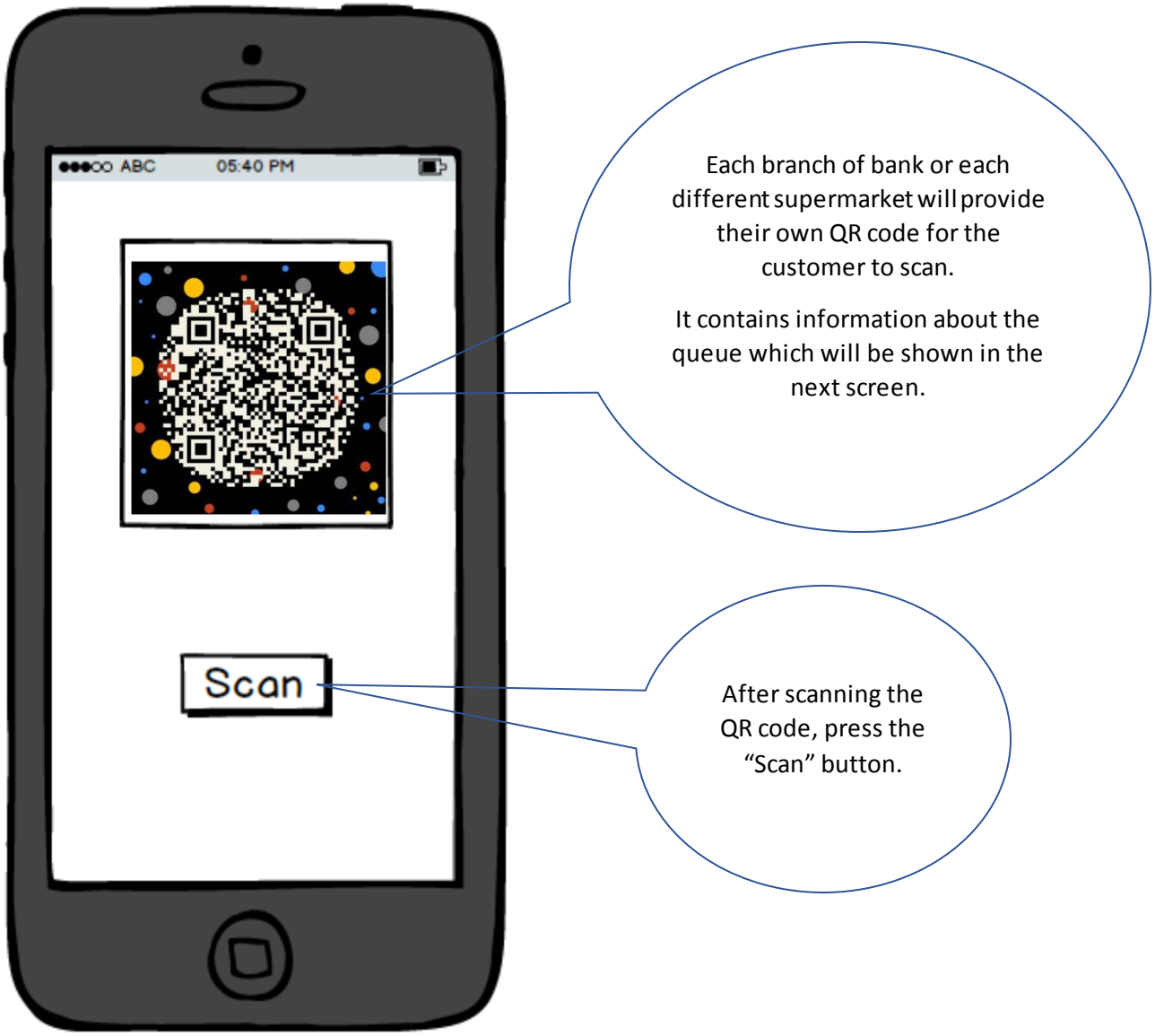
Primary target: For people who are already on site and want to check the waiting time to decide whether to join the queue or leave.

Rationale

This prototype is focused on the users who want to join the queue when they are already at the destination. The aim of this prototype is to let the user to join the queue in shortest time.

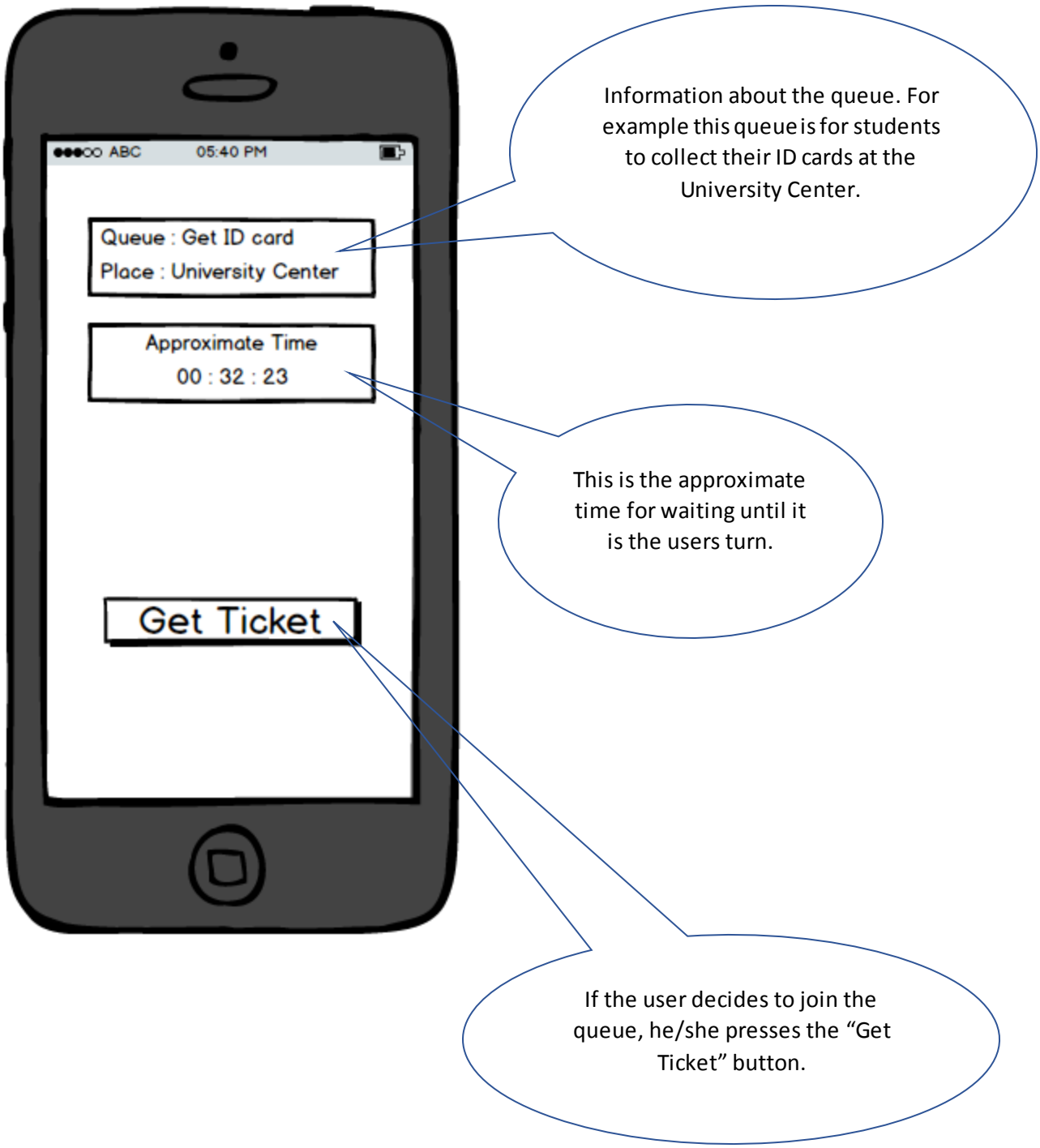
Screen 1

User arrived at somewhere and scans the QR code they provided.



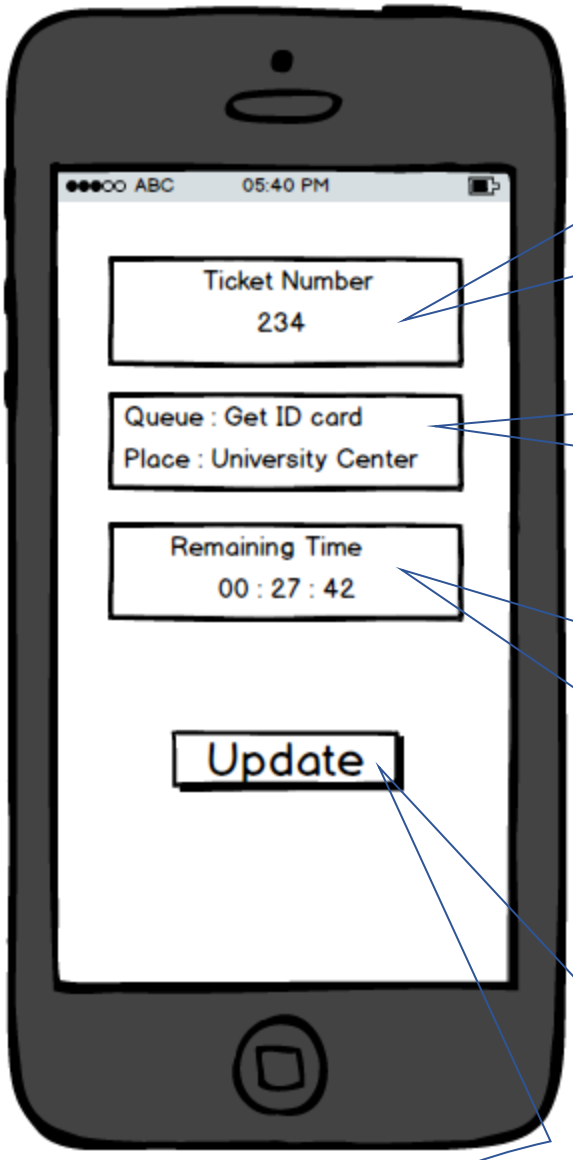
Screen 2

Scanning the QR code will provide information about the queue and the approximate waiting time. The user can decide whether he/she want to wait for that much of time.



Screen 3

After joining the queue, the screen will show the information about the ticket and the approximate remaining time.



Ticket number for different occasions. For example, banks and post office usually call numbers to their counter when they are available.

Basic information about the queue.

Approximate remaining time. It is decreasing every second, and will update every minute to inform the user if there is an advance or delay.

This button is specially designed for those who are feeling bored or impatient, so they can update the remaining time manually whenever they want.

Evaluation of prototype

Nielsen Heuristics for second prototype			
№	Criteria	Rating	Discussion / ways to solve
1	Visibility of system status	0	Clear information about the queue. After scanning the QR code, information was provided about the queue, including what is the purpose of the queue, where the queue takes place and the approximate waiting time.
2	Match between the system and the real world	1	Whole system is in English. Although English is a worldwide language, there are a lot of people who do not speak in English. But queuing on the other hand, its population is way beyond the people who speaks English. So this system needs a function to change it into different languages.
		2	The procedure of scanning the QR code might cause problems. Although the procedure of scanning the QR code takes only a couple of seconds, it might create a sub queue. This situation is unlikely, but if it does happen, posting the QR code in more than one place might be able to solve the problem.
3	User control and freedom	4	There is no “quit” or ”back” button on screen 2 and 3. If the user wants to leave the queue, or decide not to join the queue on screen 2, it will cause a problem. Adding a “back” button on screen 2 and 3 should solve the problem.
4	Consistency and standards	N/A	
5	Error prevention	2	If the store offers more than one QR code, the user might scan the wrong one. If the user scanned the wrong QR code, the information on screen 2 should be showed more clearly. This would prevent the user from getting the wrong ticket.
6	Recognition rather than recall	2	Font is relatively small and low contrast The information on screen 2 and 3 should be enlarged for a better contrast.
7	Flexibility and efficiency of use	0	The efficiency of joining queues After scanning the QR code, the system will inform user with the queue information and approximate waiting time. After the user acknowledges the time, he/she can decide whether to join the queue or to leave.
8	Aesthetic and minimalist design	2	The user interface is just plain white. The interface has not been well designed; it should contain at least some color.
9	Help users recognize, diagnose, and recover from errors	4	Same problem as No.3, and if an error occurs, there is no way of fixing it. The only information the user will get is when he/she scans the QR code, and there is no way to cancel the ticket. So the solution should be to enlarge the text of information, inform the user which queue they have joined, and add a “back” and “Leave Queue” button for the user to go to previous page.

10	Help and documentation	3	There is no user's manual and no information for how to use this system. The system should add a help or support function before the screen 1 in the main menu to guide the user.

Student

	**Scenario**	**Reason**
Scenario 1	*Wants to collect his ID Card from University Admission Office.*	• He likes this prototype and he used it with ease. He just goes to the admission office, where there is a screen, gets his queue number from the University admission office with a quick scan of the QR code, and is seen. He has never seen and he has never heard of this kind of fast system.
Scenario 2	*Wants to create new bank account to manage his budget*	• When he arrives to bank, he is a little bit confused because he normally gets a ticket by touching a button on the screen. This time he is scanning a QR code from the screen and gets a ticket number and time. He likes the practical and useful system.
Scenario 3	*Wants to send a parcel to his friend in Germany.*	• This prototype matches his needs. When he arrives at the post office he just gets a ticket by scanning a QR Code.

Businessman

	**Scenario**	**Reason**
Scenario 1	*Wants to get a loan from bank to buy a house*	• He likes this prototype, because it is easy to use and very efficient. There are some labels with printed QR codes for various services on the reception desk. He just needs to scan the QR code by using queue application, and then he can decide whether to join this queue.
Scenario 2	*Does not want to stay in the queue for long when waiting to meet a doctor*	• When he arrives at the hospital, he just needs to scan the QR code from the screen and then the information of the ticket and approximate remaining waiting time will be shown on his phone. The remaining time is updated automatically. He likes this convenient application.
Scenario 3	*Wants to post a parcel to his partner*	• This prototype is useful to him. When he arrives at the post office he just gets a ticket by using his phone to scan the QR Code. The whole procedure of joining the queue requires only 3 steps.

Elderly person

	**Scenario**	**Reason**
Scenario 1	*Withdraw some money from his pension bank account.*	• Robert wants to withdraw some money and for this reason he goes to the bank and uses the 2nd prototype application. The first thing after launching the app is scanning QR code to get a ticket for operation in the bank. After scanning, the place and approximate time is shown. On the third page again readability is poor for the elderly person. It is also tedious for him to update the remaining time every minute.
Scenario 2	*Shopping from supermarket*	• When Robert does his shopping in a supermarket he wants to easily get a ticket and not to wait a long time. This app is not as complicated for him as the previous one was, nevertheless the easiest way to get a ticket for him would be to just show the place automatically and receive the remaining waiting time.
Scenario 3	*Send a parcel to his son who lives in California.*	• This application is very useful to get a ticket for a queue in seconds. However, in this case you have to be in the bank/post office/supermarket. He wants to get a ticket before going to the post office. It is inevitable to need to wait in a queue even using this app.

PROTOTYPE 3

Description of prototype

Tool used: Mockup

Primary target: Create an application that can join queues instantly.

Rationale

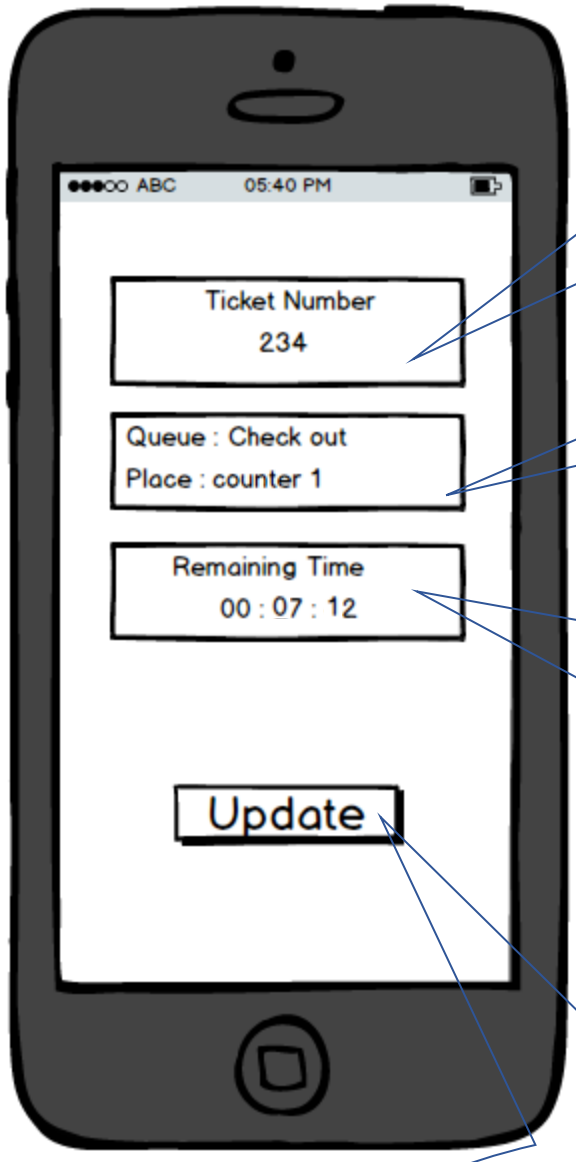
As the location function has been widely used in smart phones, it is advisable to use it in the queue application. Therefore this prototype will design the interface based on the location function to make this application more intelligent, it will focus on the distance to the destination.

Screen 1

According to the user's smart phone GPS system, his/her phone can tell the user exactly where he/she is. After the user makes sure of his/her location, he/she can join the queue instantly.

Screen 2

After choosing the right queue, the user joins the queue instantly.



Ticket number for different occasions. For example, banks and post office usually call numbers to their counter when they are available.

Basic information about the queue.

Approximate remaining time. It is decreasing every second, and it will update every minute to inform the user if there is an advance or delay.

This button is specially designed for those who are feeling bored or impatient, so they can update the remaining time manually whenever they want.

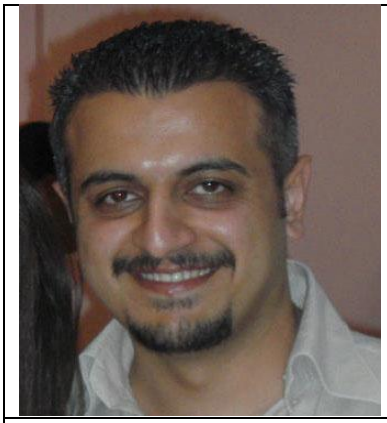
Evaluation of prototype

Nielsen Heuristics for third prototype			
№	Criteria	Rating	Discussion / ways to solve
1	Visibility of system status	1	No provision about the internet status, and the server status. The queue joining system is based on internet connection, so without internet connection this system will fail. Bad internet connection could cause the data transfer between the smart phone and server go wrong. It should show the internet connection for the user to make sure the user did successfully get the ticket.
2	Match between the system and the real world	1	The whole system is in English. Although English is a worldwide language, there are still a lot of people who do not speak English. But queuing on the other hand, its population is way beyond the people who speaks English. So this system needs a function to change it in to different languages.
3	User control and freedom	4	There is no exit queue button on the ticket screen. This type of system is aimed at joining queue instantly, so the scenarios for this prototype are more likely to occur in stores; either way the user needs to wait and check out, so it is less likely for the user to quit the queue. Nonetheless, it should have a quit queue function on the ticket screen.
4	Consistency and standards	N/A	
5	Error prevention	4	Users could mis-click the stores when the map pops out. This is a major problem since it only needs the user to click twice, once on “Get Location” and second time on clicking the location. And if the user selects the wrong location, he/she will end up joining the wrong queue. One way to solve this is to add a confirm step after clicking the location, or enlarge the map to a size that can reduce the mis-clicking rate.
6	Recognition rather than recall	2	Font is relatively small and low contrast The information on the ticket should be enlarged for a better contrast.
7	Flexibility and efficiency of use	0	The efficiency of joining queues This system is aiming for joining queue instantly, so it minimizes the steps into two clicks, it does not have a flexibility problem since its goal is to join a queue.
8	Aesthetic and minimalist design	2	The user interface is just plain white. The interface has not been well designed; it should contain at least some color instead of just black and white.
9	Help users recognize, diagnose, and recover from errors	4	Same problem as No.5, and if an error occurs, there is no way of fixing it. The only information the user will get is when he/she gets the ticket, and there is no way to cancel that ticket. The solution should be: enlarge the text of information, letting the user know clearly if they have joined the wrong queue, and add a “Leave Queue” button for the user to select again to join the correct queue.
10	Help and documentation	3	There is no user’s manual and no information for how to use this system. The system should add a help or support function before the screen 1 in the main menu to guide the user.

Student

	**Scenario**	**Reason**
Scenario 1	*Wants to collect his ID Card from University Admission Office.*	• He thinks it is a new generation system and he is a little bit under pressure on how to use it well at the university, but he gets a ticket number to get his ID card.
Scenario 2	*Wants to create a new bank account to manage his budget*	• He cannot use it very well here because he finds the location on the map but there are different branches of banks. Although he has a good technology background he is confused.
Scenario 3	*Wants to send a parcel to his friend in Germany.*	• He can use it to find a post office which is nearest to his home.

Businessman

	**Scenario**	**Reason**
Scenario 1	*Wants to get a loan from bank to buy a house*	• He believes it is the most convenient application he ever seen. Because the nearby bank branches will be displayed on the map when he open this application. This application uses GPS function of the phone to locate the current position of him.
Scenario 2	*Does not want to stay in the queue for long when waiting to meet a doctor*	• This prototype can meet the requirements of this scenario, but if his location is far away from that of hospital, the application may not be useful in that situation. He needs to drag the map many times to find the hospital.
Scenario 3	*Wants to post a parcel to his partner*	• He can use it to find a post office which is near to his home or office. This prototype is a convenient way for him to send a parcel and will save his time.

Elderly person

	**Scenario**	**Reason**
Scenario 1	*Withdraw some money from his pension bank account.*	• If Robert wants to withdraw some money but doesn't know of any banks nearby, so this 3rd prototype application tells him where he is and gives him the names of local places. He can now get a ticket. This is a good approach for elderly people so that they do not get confused with the different steps of the app.
Scenario 2	*Shopping from supermarket*	• He chooses the place from the queue application and gets the ticket to the check out. It is very easy and quick for him. But the map is not clear for him. Robert's technology skills are poor. Therefore it is not simple for him to interact with the map. Also the labels on map are too small for him to see.
Scenario 3	*Send a parcel to his son who lives in California.*	• The queue application shows the nearest available places to choose. It is very convenient to use. But when he chooses a place he automatically gets a ticket. It is impossible to change or cancel an appointment.

Conclusion of Low Level prototypes

We have created three prototypes using Mockup. Mockup has a lot of good features to build the models of our application. These three prototypes presented slightly different approaches for solving the queue problem. During the creation process we found it easy to use. It is efficient to help us to build models in less time.

After building each prototype we evaluated it with Nielson's ten usability heuristics and went through user approaches. We found various weaknesses and positive aspects of the three prototypes and will apply them to the second generation prototype.

In the first prototype there are some weaknesses, for instance it is not a user-friendly system. Therefore it was difficult to use and interact with the application, especially for elderly persons. Many screens for receiving tickets takes a lot of time. For this reason it was not efficient. We then created a second prototype to overcome this problem.

The second prototype has been developed after an evaluation of the first one. Many steps to get a ticket for a queue have been eliminated in this prototype. Hence we added the step of simply scanning a QR code to receive a ticket which minimized steps. During evaluation of the prototype some other problems had occurred. Problems with scanning would appear easily. Also if someone wants to reserve a place beforehand. It is not possible in this case. A person should be in a place where he/she has to scan a code. We settled this problem.

The last thing we did was create a third prototype. This prototype is very useful and easy to use for almost everyone in the situation of finding a place to get a ticket. There are some minor problems in the third prototype as well. The design is poor. When you click in a place you automatically get a ticket without confirming the process. Therefore mis-clicking a place in a map can cause the wrong ticket being bought.

In conclusion, after evaluating and seeing user behaviors whilst using the prototypes it is easier to begin to build the second generation prototype. We defined problems and will correct these in the next step.

Second Generation Prototype

Rationale

We have combined 3 different options for this prototype because users can use it in different situations and places. Also to make and develop a first generation prototype and to make it better so that people can get a better application.

EVALUATION OF TOOLS FOR CONSTRUCTING THE PROTOTYPE

Before the stage of developing the second generation prototype we evaluated three different solutions: Microsoft PowerPoint 2010, Balsamiq Mockups, Pencil Project.

After evaluating these tools we chose Pencil Project.

Microsoft PowerPoint 2010

It is one of the most popular tools in use, and it is mentioned in the prototype tool suggestion. Our team members have some experience of using this tool, but because we are focusing on creating a smart phone application, this tool lacks templates and stencils for particular objects.

Balsamiq Mockups

This is another tool that has being mentioned in the prototype tool suggestion; we have used it in our first generation prototype. It is easy to use for drawing the system flow chart, but it is a little too sketchy for our second generation prototype since we are using personas to do a more detailed evaluation.

Pencil Project

This tool is recommended by other teams, because we are trying to build a smartphone application prototype, with the templates and stencils we can make it as detailed as possible, so this tool totally suits our need. And since we are trying to overcome one of the defects that Nielsen Heuristics has found for our first prototype, which is the “Aesthetic and minimalist design” with the interface design style of iOS system, the stencils for the iOS system fits in perfectly.

Flow Chart


Starts here
Queue Solution
English
Deutsch
Español
Français
日本語
繁體中文
簡体中文
Map
Reservation
QR Code
Ticket
Settings
Help
My Favorite
Restaurant
Hospital
Others
Back
Reservation
Search
University of Birmingham
Country
City
Map
Locate Self
Ryman
Stationery, Office Supplies & Technology
Cancel
Confirm
Scan
QR Code
Ticket Number : 247
Queue : Checkout
Place : Counter 2
Remaining Time
00:23:35
Ticket
Ticket Number : 247
Queue : Checkout
Place : Counter 2
Remaining Time
00:23:35
Quit Queue
Update Time
Ticket Number : 86
Reservation : University of Birmingham
Place : Admissions Office
Date : 13 / Sep / 2014
Time : 13 : 00
Cancel Reservation
Quit the Queue?
Stay
Quit
Keep
Cancel
August
September
October
Department
Time Table
12 : 00
13 : 00
14 : 00
Get Ticket
Queue : Customer Service
Place : Desk 3
Remaining Time : 01 : 04 : 27
Join this Queue?

DESCRIPTION OF PROTOTYPE

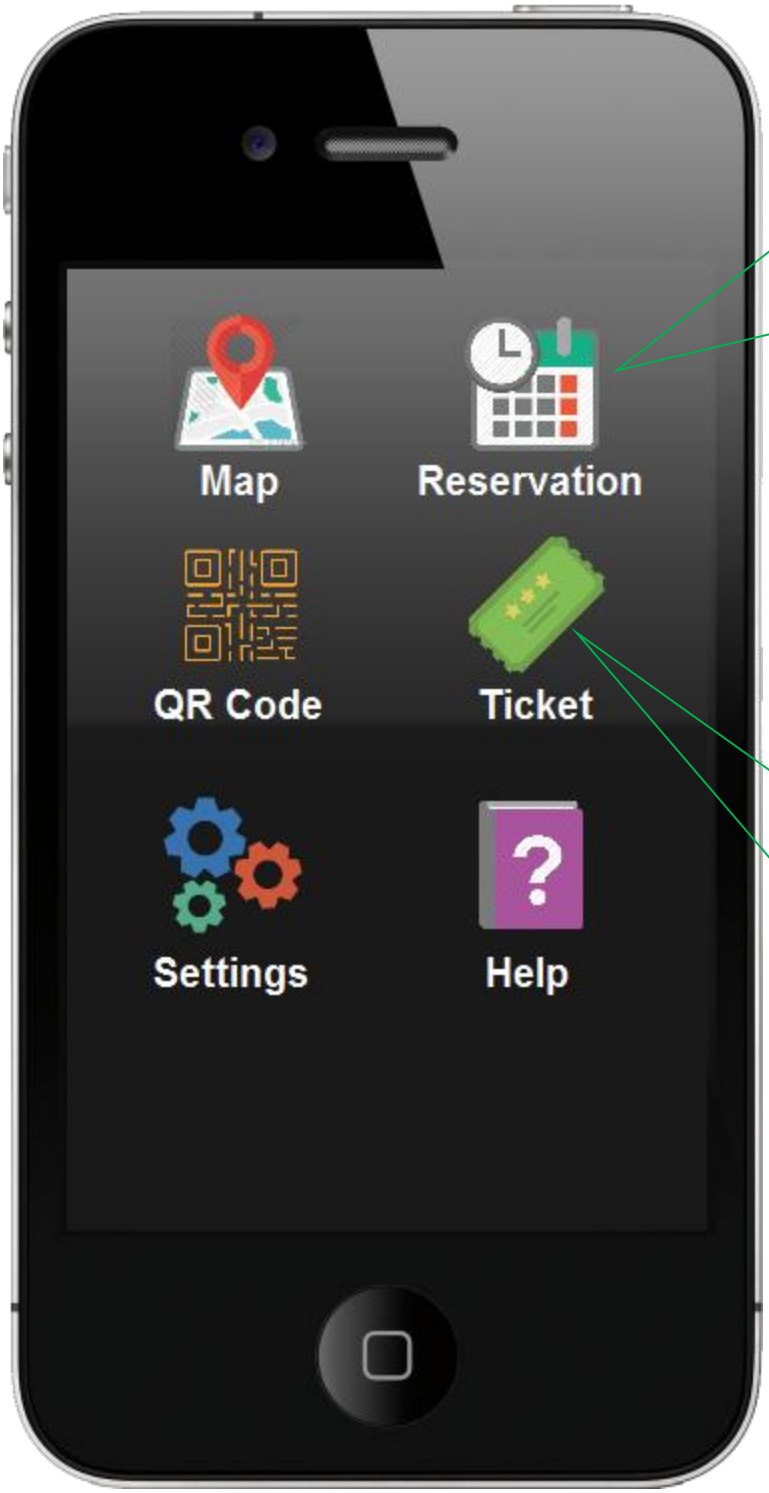
Tool used: Pencil

Start Screen

This screen will only show on the first time that this application is started. The user can tap on the language that he/she prefers. In the future the user has to enter Settings to change the language.

Main screen

After choosing the language, the application will enter the main screen.

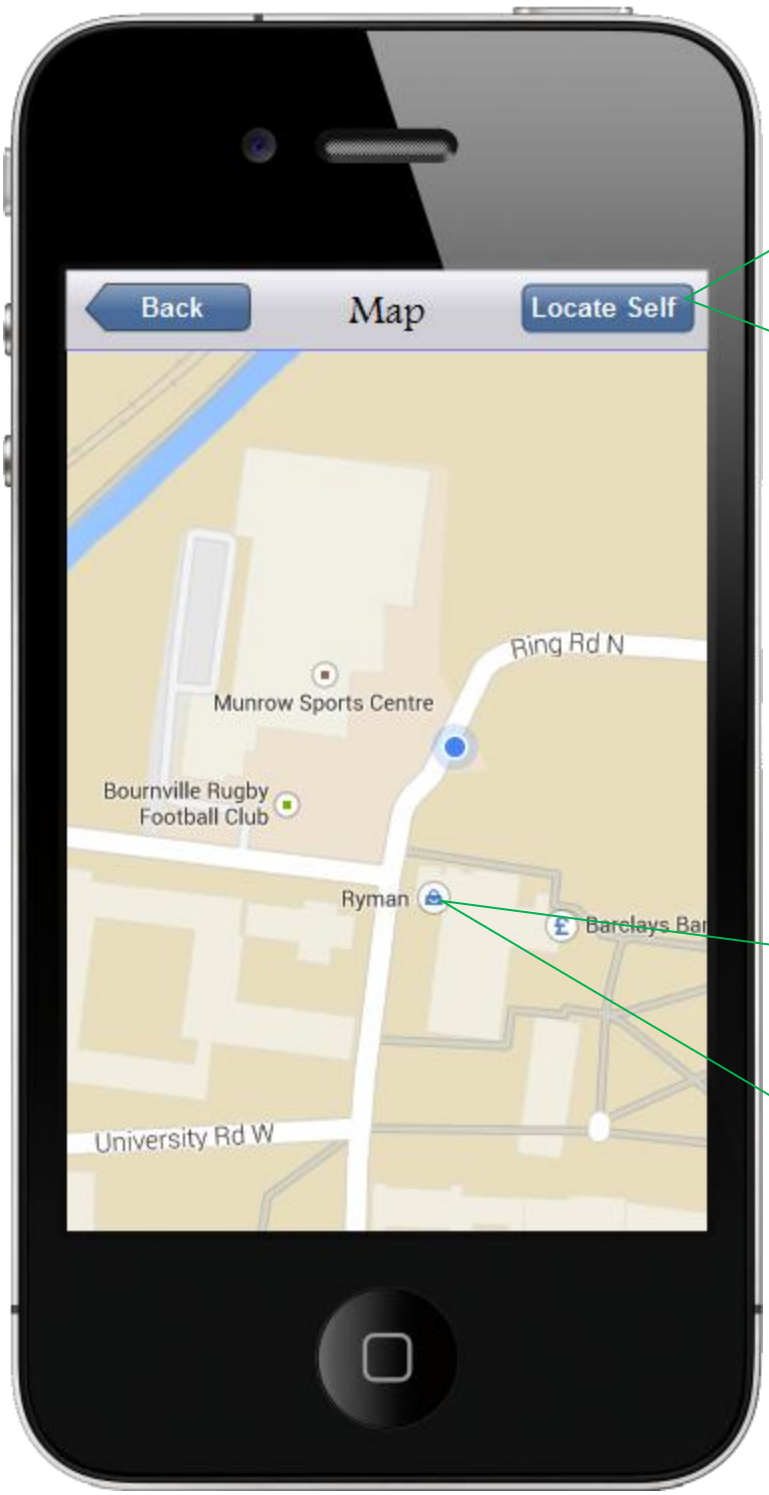


The user can decide which mode is suitable for the situation he/she is in. There are Map, QR Code and Reservation modes.

The ticket icon is for the user to enter the Ticket screen and check the ticket that he/she has already got, or the reservation he/she has already booked.

Map

After enter the Map mode, the application will show the stores with this system in use nearby, the user can drag or enlarge the map if he/she wants. The user has to choose the store in which they wish to join the queue.

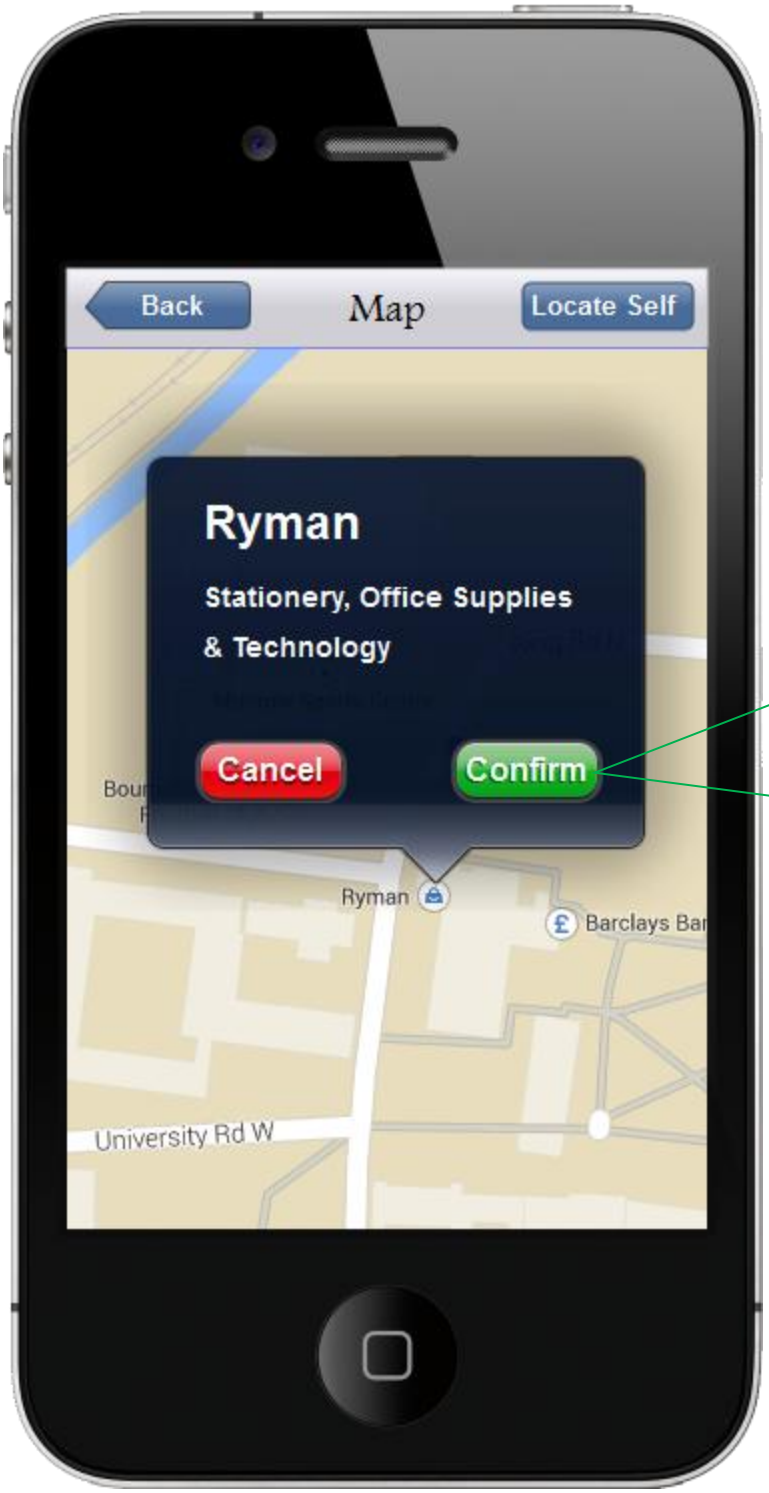


The user can tap on the "Locate Self" button to relocate himself/herself at the center of the screen.

The user has to choose the store they are in and click it. Because smart phone location systems sometimes are not that accurate.

Map 2

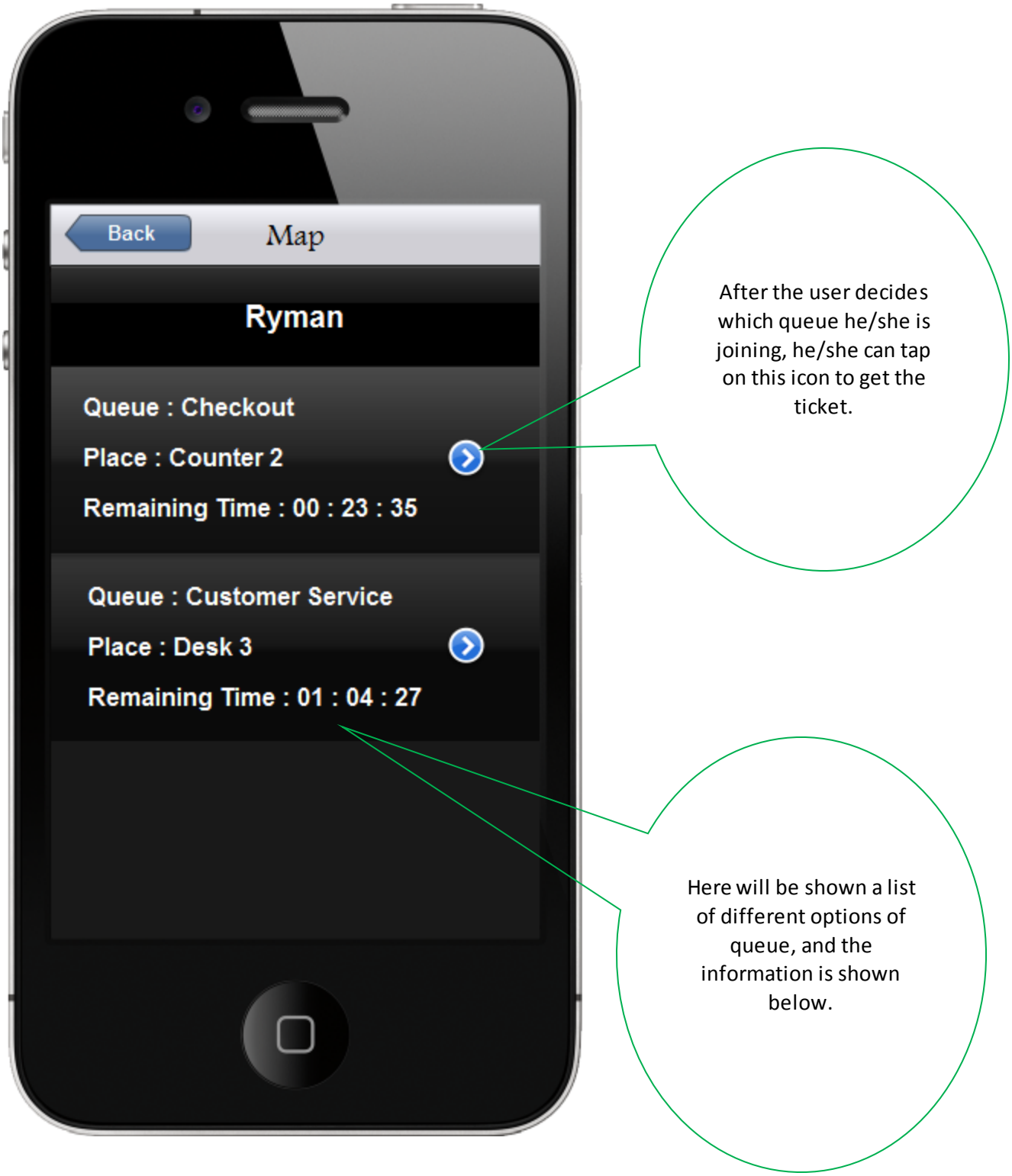
After tapping on the location the user wants, the information of the store will pop out, and the user can confirm if it is the right store.



After the user confirms it is the right store that he/she is in, the user can tap on the "Confirm" button.

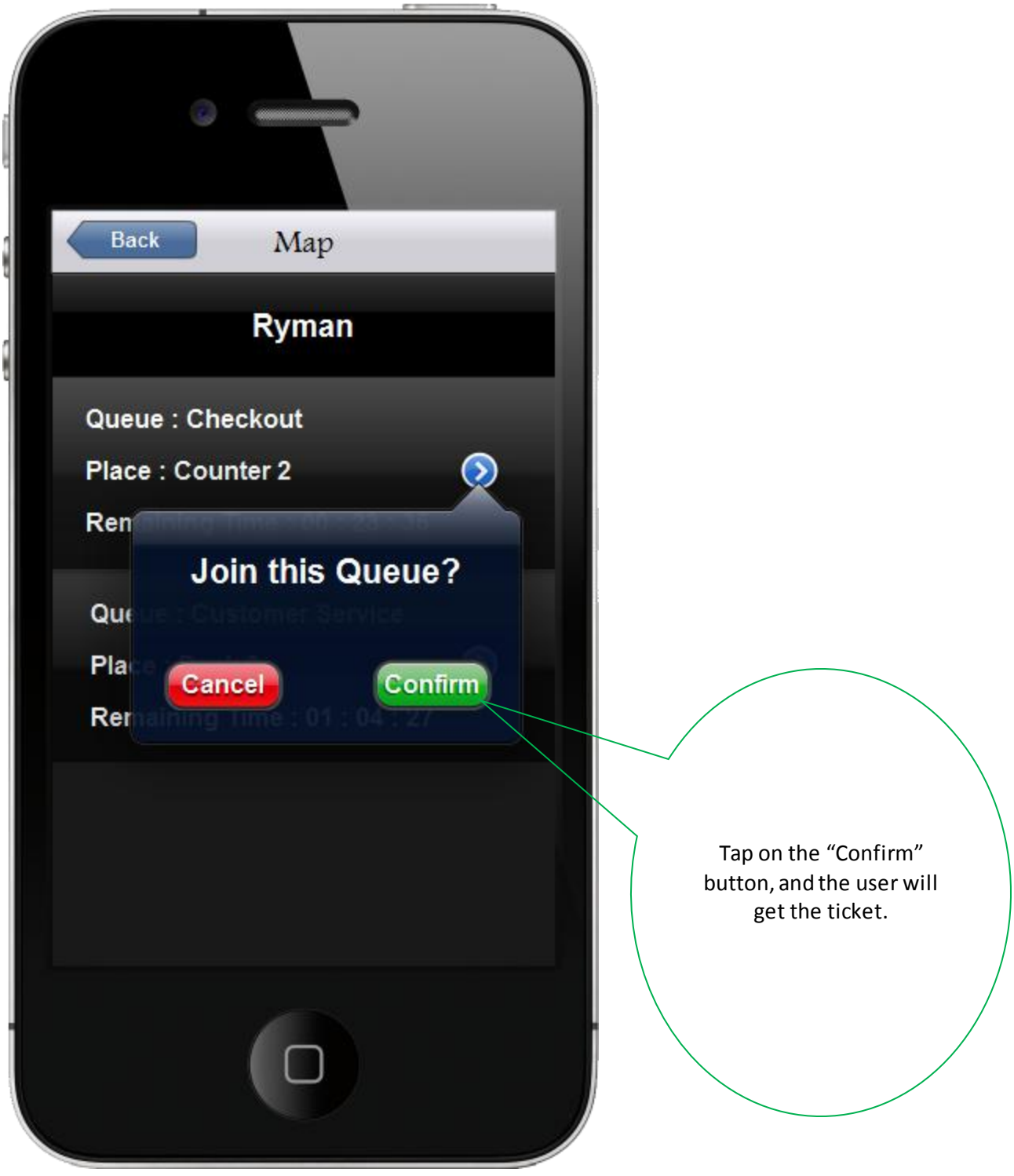
Map 3

After confirming the store, the options of the queue in the store will be shown.



Map 4

An information box will pop out for the user to confirm whether he/she wants the ticket.

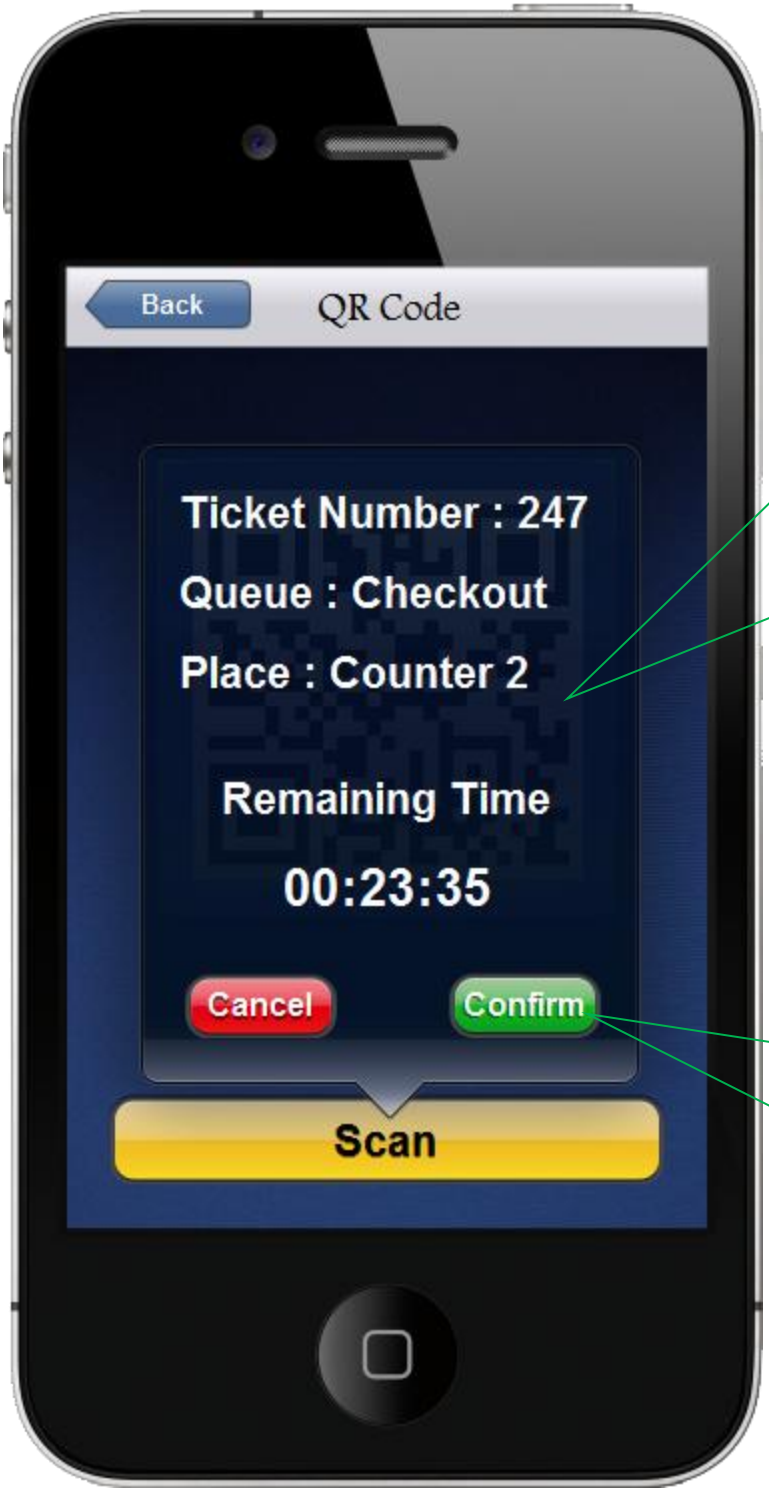


QR Code

The user enters the QR Code mode when he/she is at a store which provides a QR code for scanning in order to join the queue.

QR Code 2

After tapping on the Scan button, the information of the ticket will pop out, and the user can choose if they want the ticket or not.



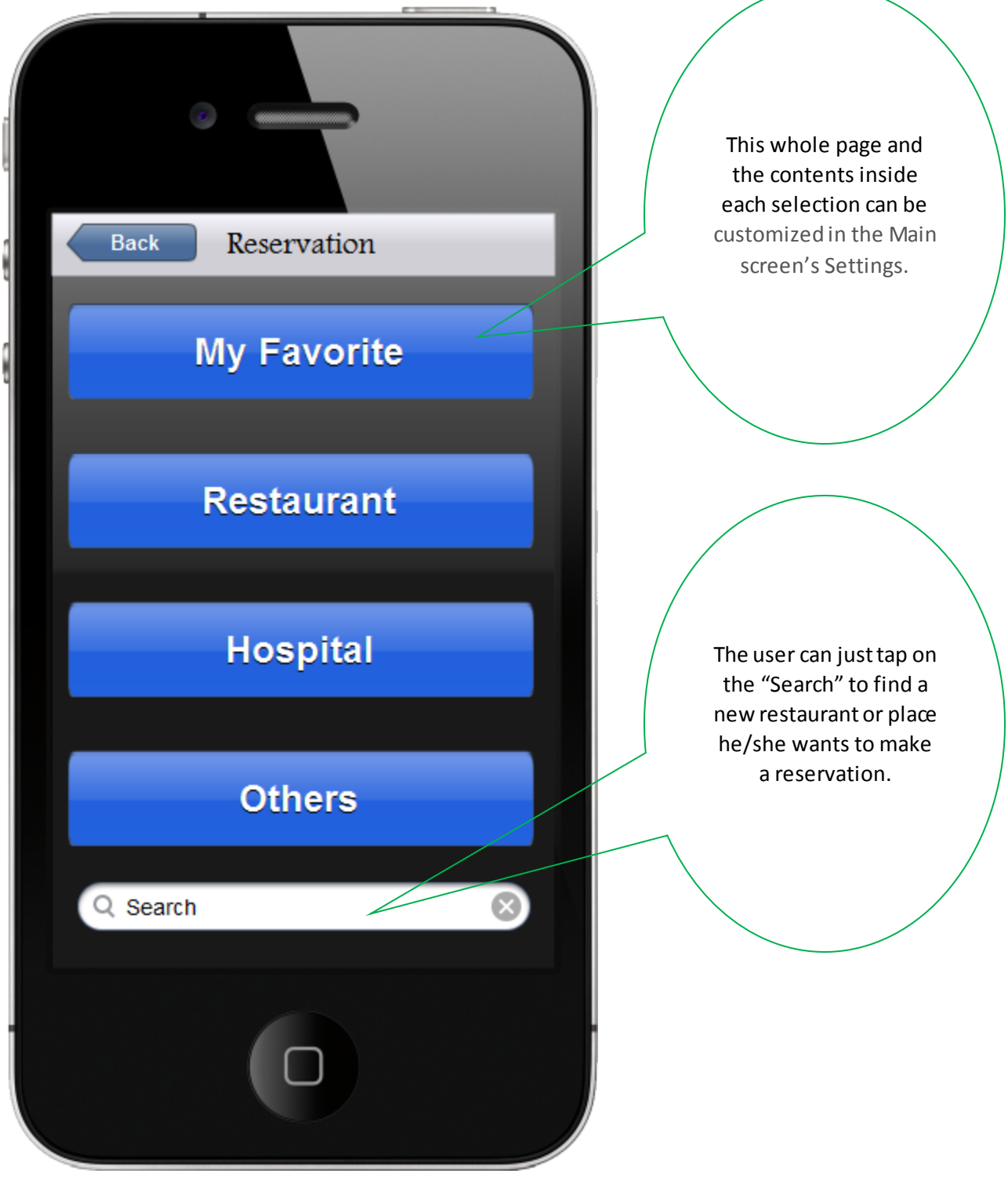
The information contains ticket number, where the place is and what is its purpose. Below, it shows the approximate remaining time.

After tapping on the "Confirm" button, the system will jump to the Ticket screen.

Reservation Mode

The Reservation mode's primary target is for people to make reservations easily.

After entering the main screen for reservation, the user can choose the place he/she wants to make a reservation. Or the user can tap on search to find the place he/she wants.

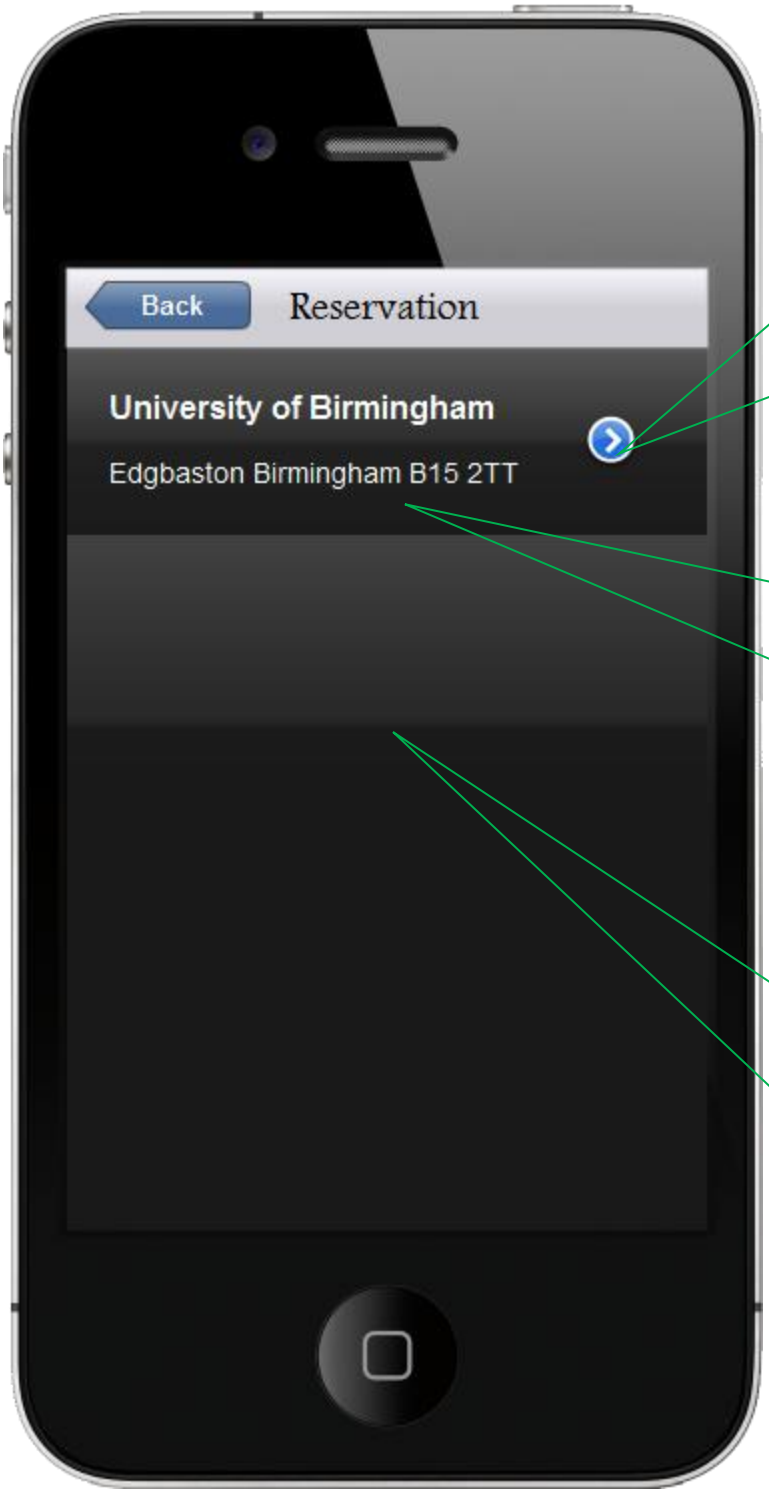


Reservation Search

After the user enters search, the system allows the user to type the place he/she is trying to find, and below the user can choose which country or city in which to narrow the search.

Reservation 2

After searching or tapping on the My Favorites button on the Reservation Main screen, the system will show what the user has chosen, in this case, University of Birmingham.



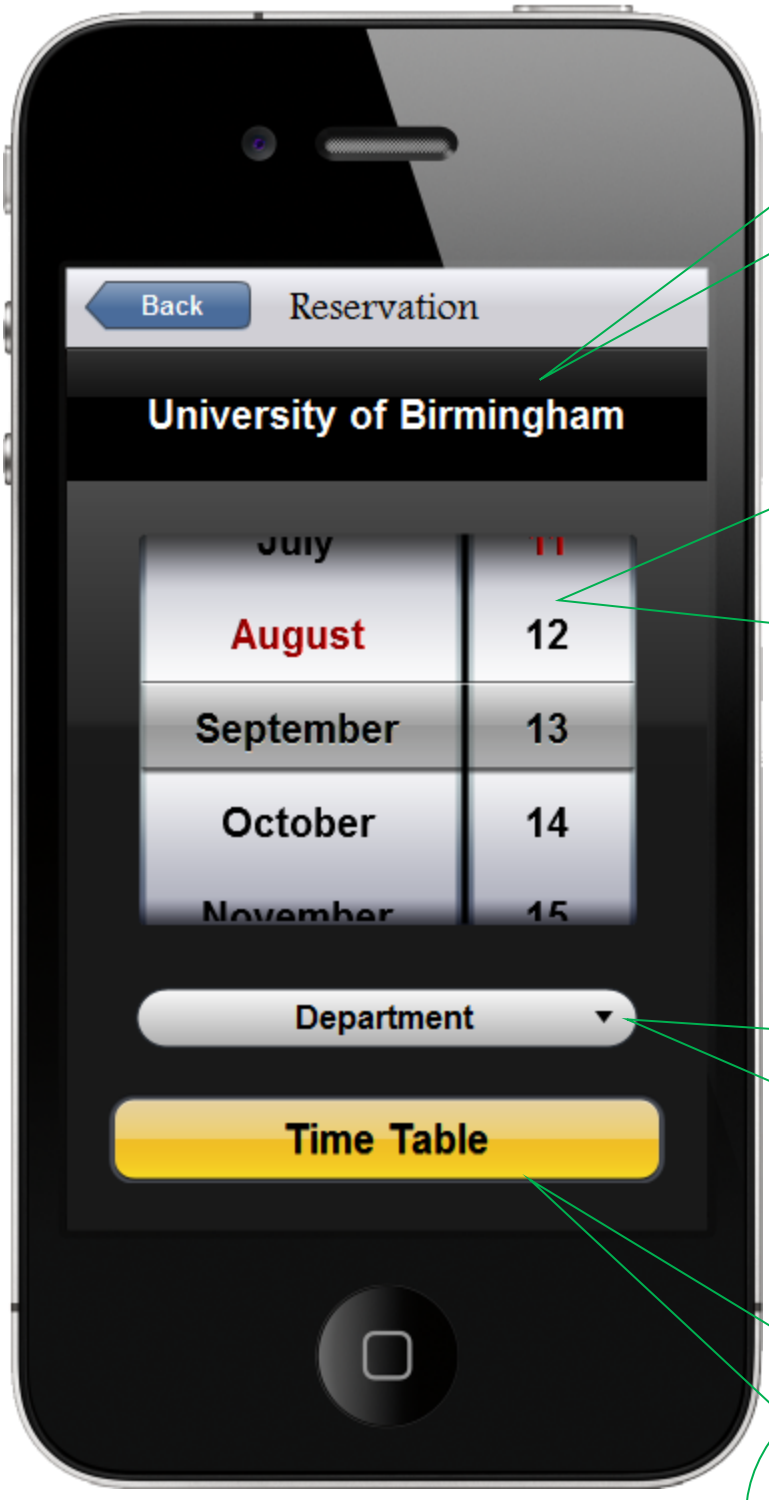
The user taps on this button if it is the right place he/she wants to make a reservation.

This shows the address of the place the user has searched.

If the user searched something like Sainsbury's or Tesco, here will be a list of Sainsbury's or Tesco with different addresses.

Reservation 3

After choosing the place, the user has to select the date for the reservation.



Here shows the place the user previously selected.

The user can simply scroll up and down to select the date he/she wants.

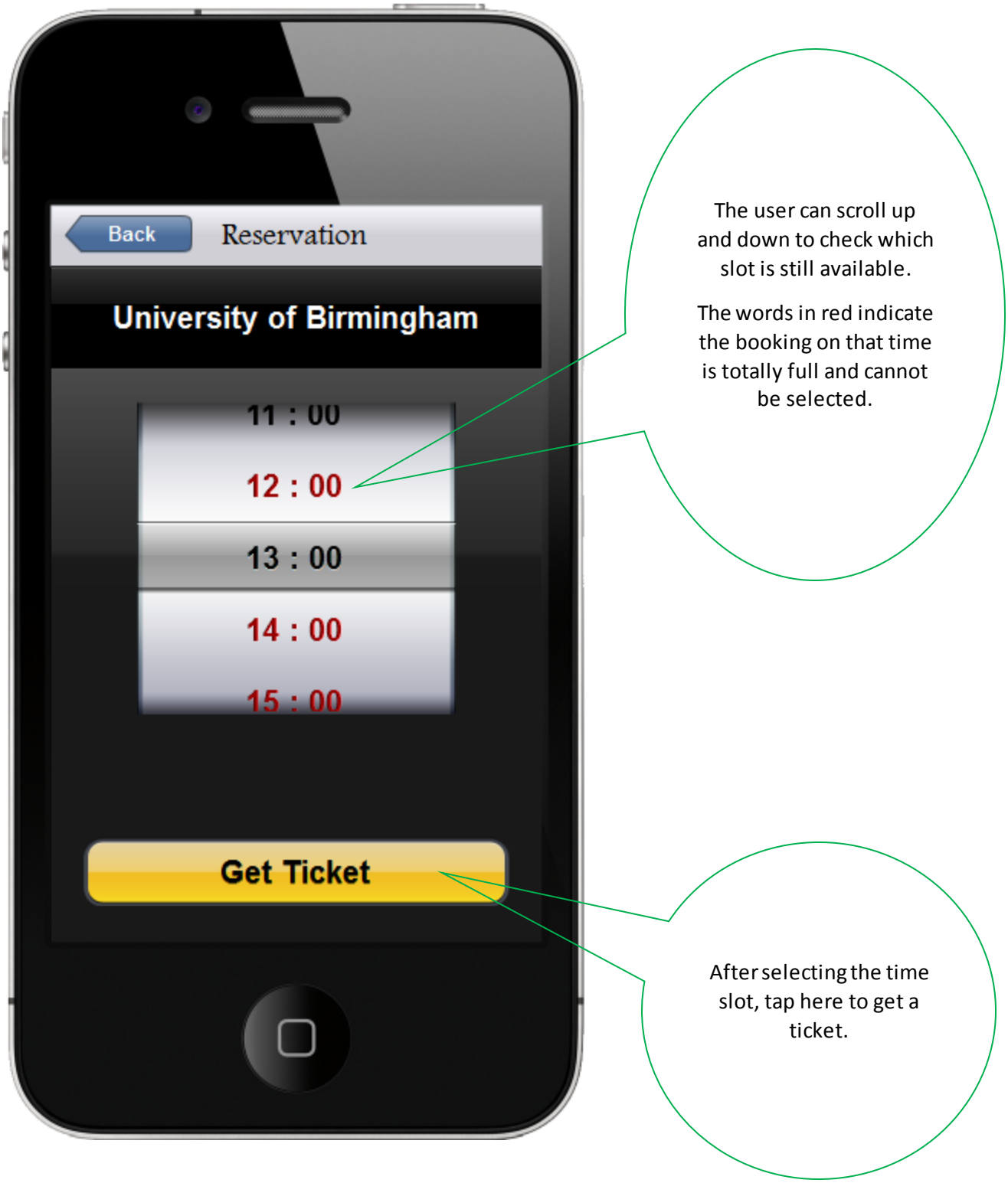
The word which is red means that the booking on that date is totally full or the day has passed and cannot be selected.

There are different departments for the user to select.

After selecting the date and department, tap here to check the Timetable.

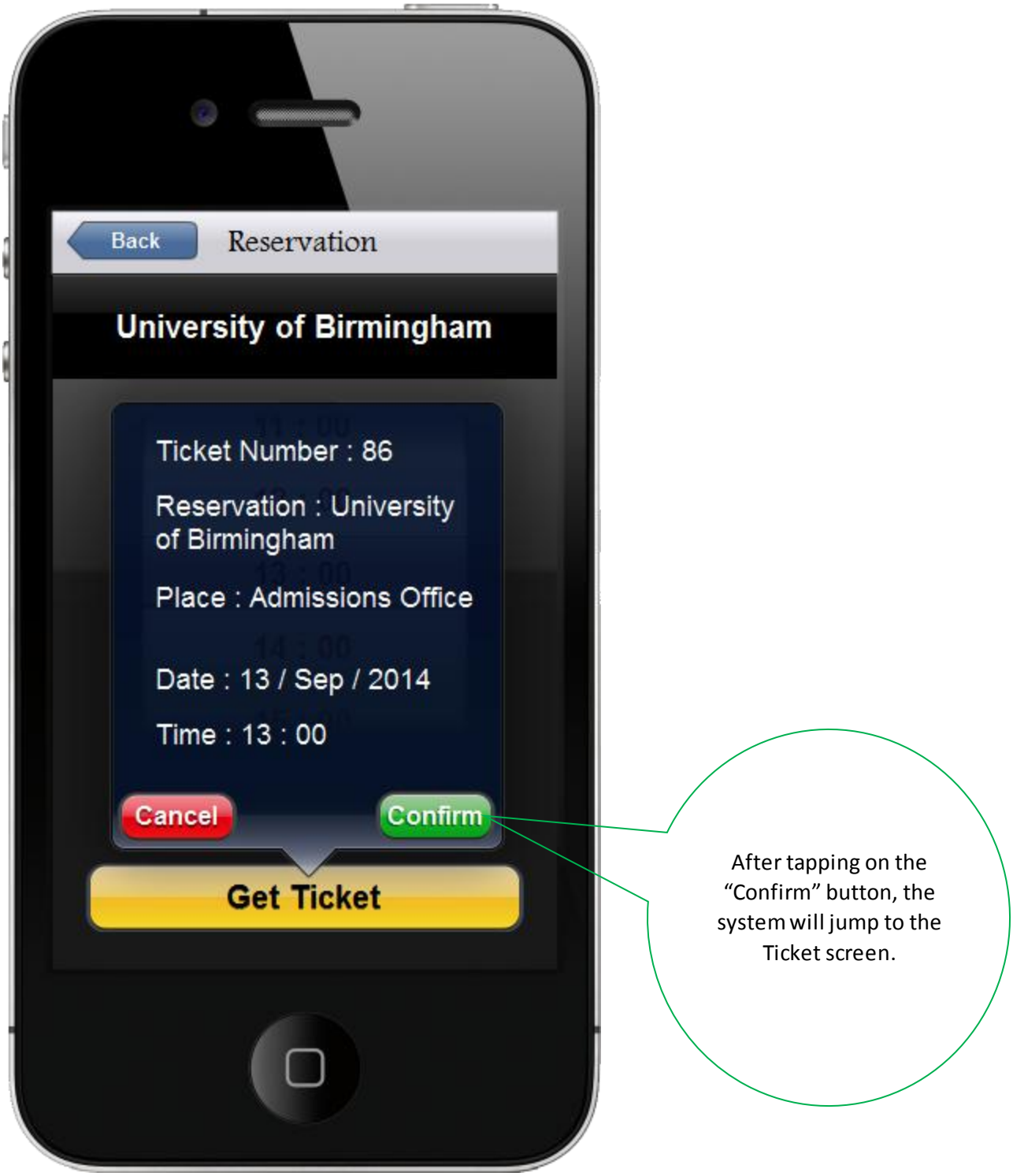
Reservation 4

After choosing the date, the user enters the time table and selects a slot for their reservation.



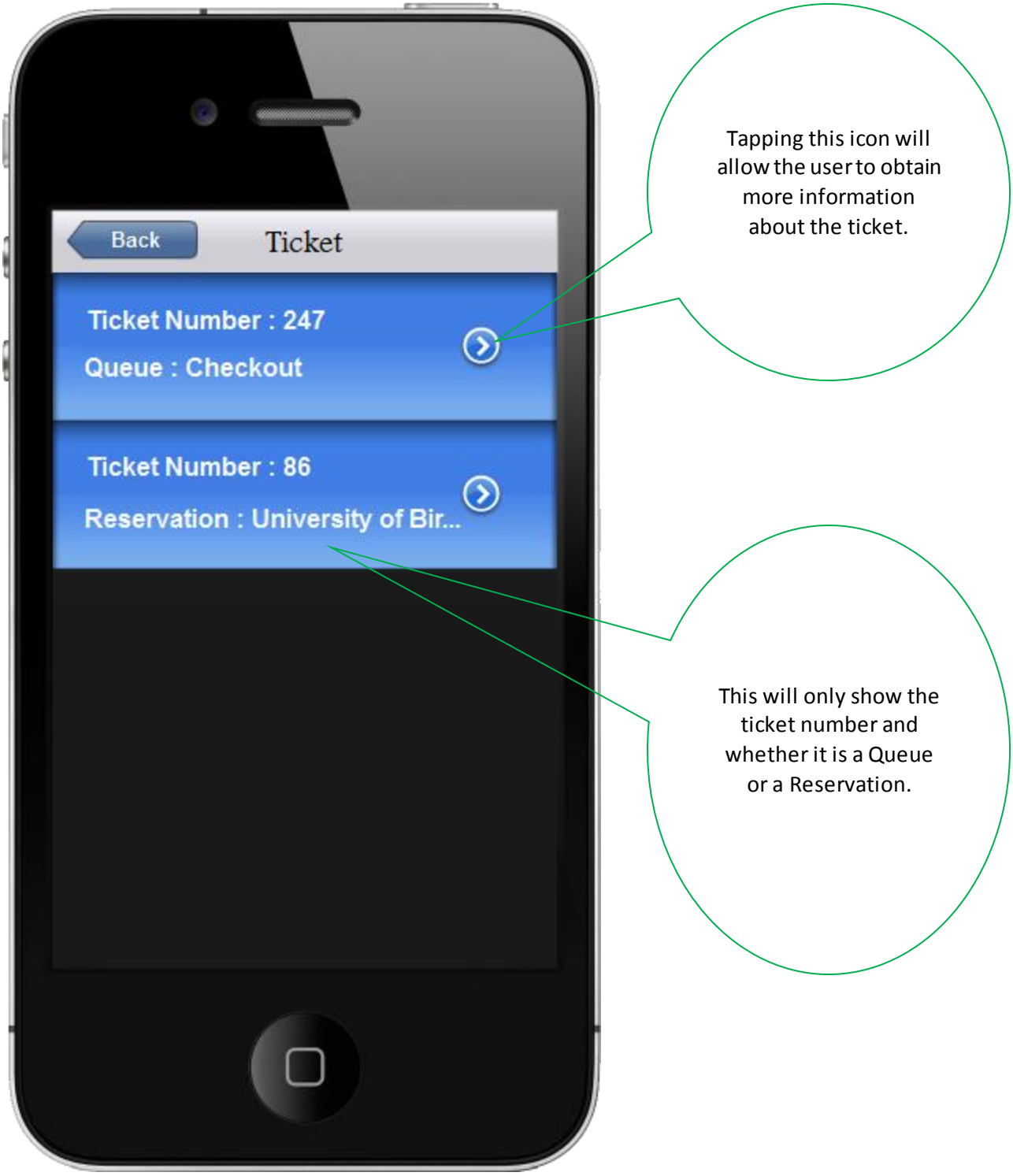
Reservation 5

Before getting the ticket, an information box will pop out like always, for the user to confirm whether he/she wants the ticket or not.



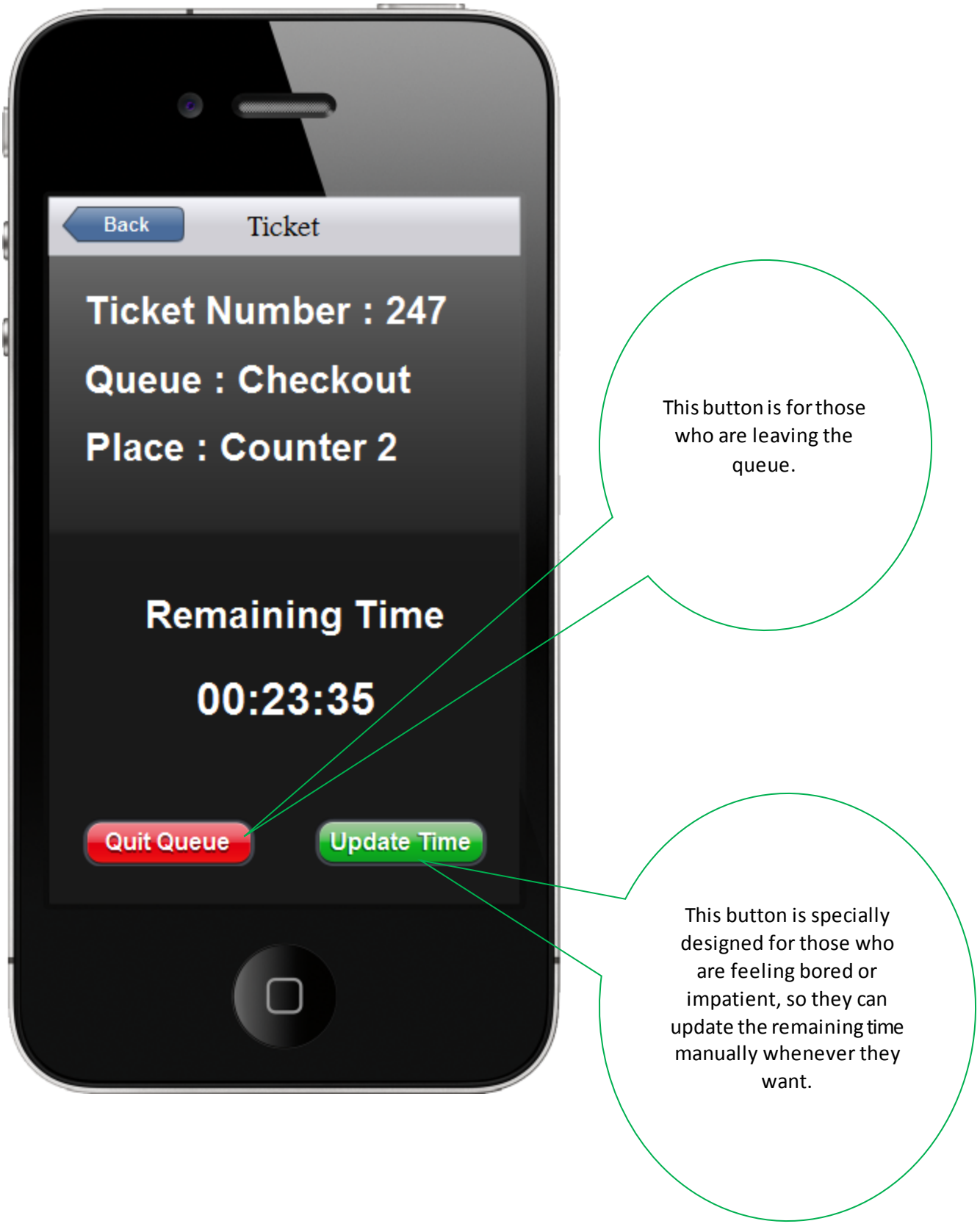
Ticket Main

After tapping on the Ticket icon, the user will enter the Ticket Main screen. It will list all the tickets the user has.



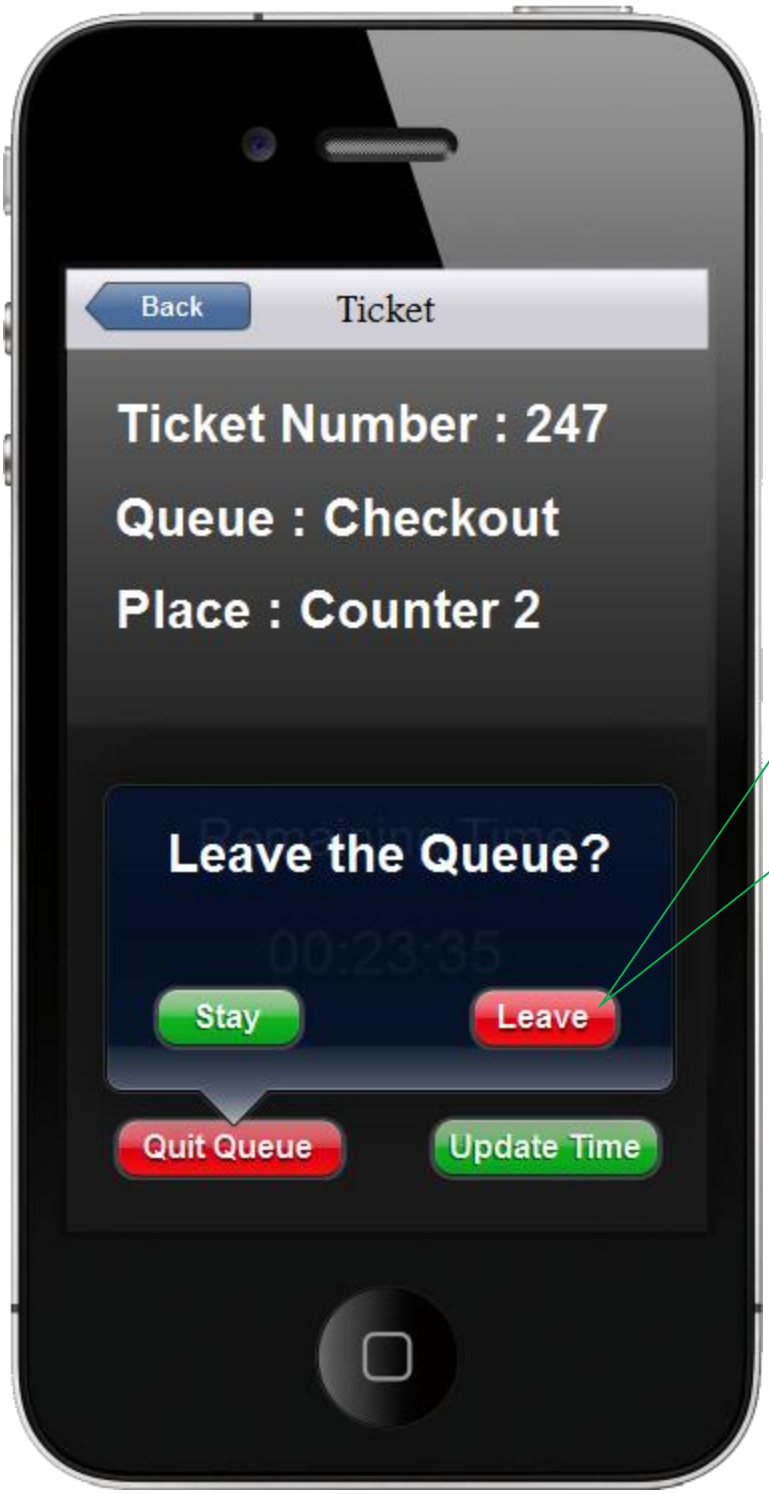
Ticket Queue

This is the information for the Queue ticket, and the Remaining Time below will reduce every second and be updated every minute (this can be customized in the Settings).



Ticket Queue 2

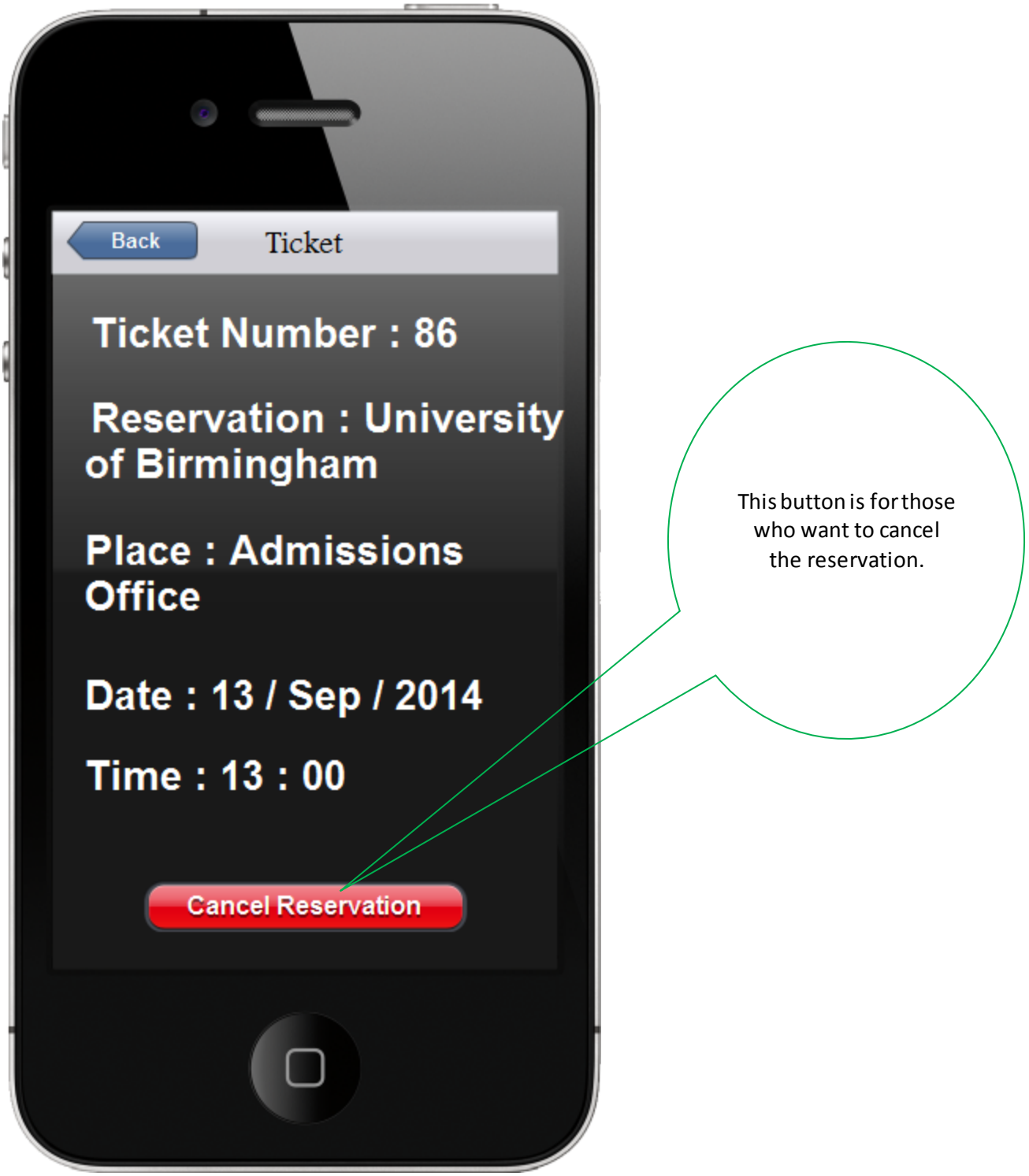
After the user decided to leave the queue, a confirmation box will pop out.



This confirmation box is to double check if the user really wants to leave the queue or did he/she just mis-click. If he/she clicks on “Leave”, the ticket will be deleted.

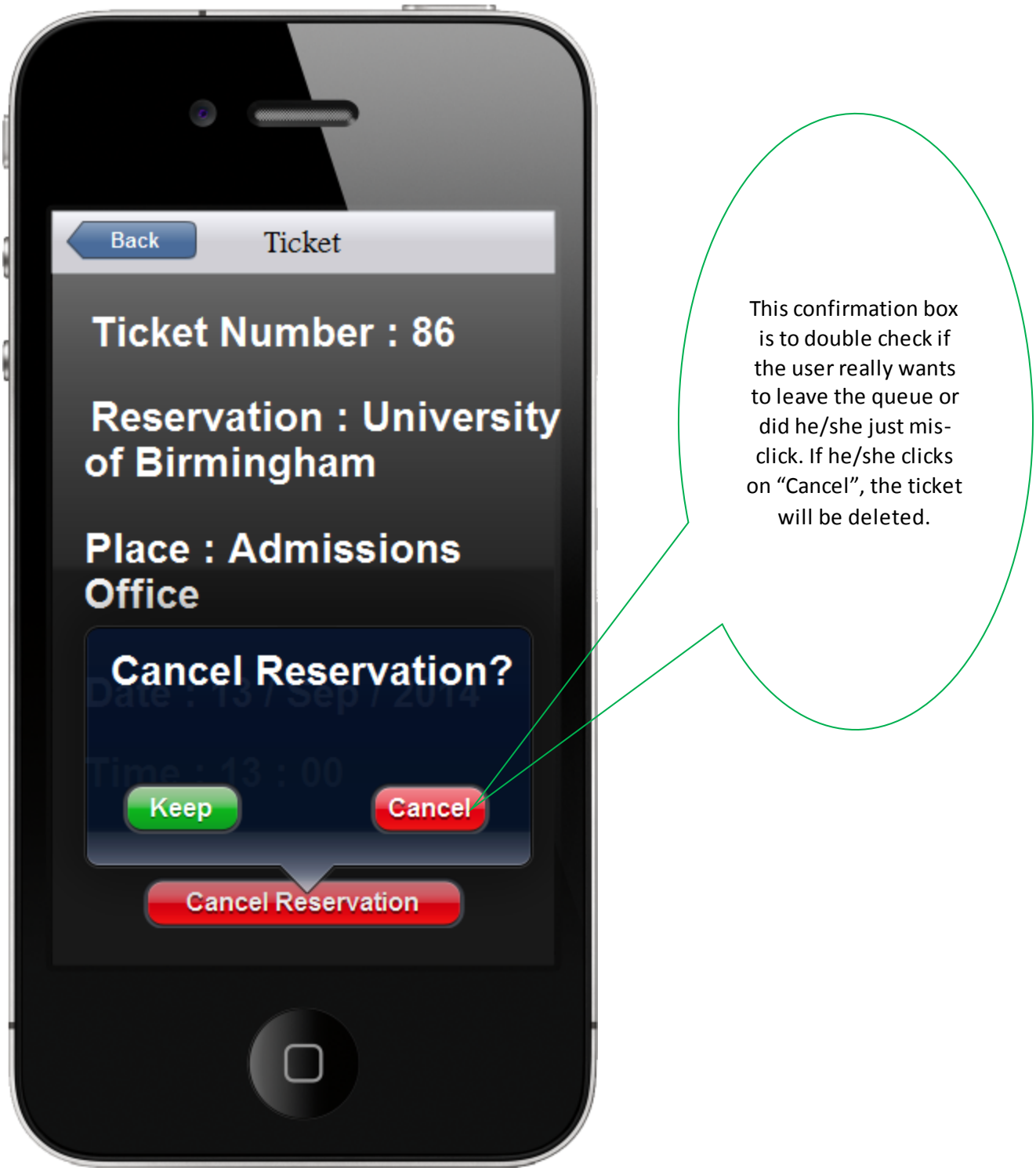
Ticket Reservation

This is the information for the Reservation ticket, it clearly shows the ticket number, place, time and date for the reservation.



Ticket Reservation 2

After the user decides to cancel the reservation, a confirmation box will pop out.



EVALUATION OF THE PROTOTYPE

A plan for the evaluation of the prototype

We decided to evaluate our second generation prototype with different methods. We are going to utilize Nielsen's Heuristics, a cognitive walkthrough and user testing methods.

Initially, we are going to determine the rules of cognitive walkthrough. Our group has agreed that it will be used against our three personas. We will examine nine scenarios using methods of evaluation.

Moreover, it will measure usability testing for evaluation. Two real users are going to use our queue application in order to give us feedback to analyze it.

After finishing usability testing the second prototype will be evaluated by the method of the Nielsen Heuristic.

At the end we will present our results and conclusion.

Cognitive Walkthrough

Polson et al. (1992) suggests that "the cognitive walkthrough (CW) aims to provide a new tool for assessing the usability of a system, and assigning causes to usability problems, early in the design process." The purpose of using cognitive walkthrough in a design evaluation step is to evaluate whether the user can be guided correctly by the information which is provided by the interface of the application in the process of using this application, and evaluate the ease at which this application can be used (Polson et al., 1992).

Since Cognitive walkthrough focuses on task, three different scenarios will be converted to tasks for different personas. Each step in the process will be assessed. To be more specific, we will be using forms to indicate whether the step is success or failure.

The following four criteria will be used to assess whether each step is a success or failure (Novick, 1999):

1. "Will the user be trying to achieve the right effect?"
2. "Will the user notice that the correct action is available?"
3. "Will the user associate the correct action with the desired effect?"
4. "If the correct action is performed, will the user see that progress is being made?"

Evaluation of scenarios based on the experience of the elderly person

Task 1 – Withdraw money from his pension bank account.

Goal: Elderly persona – Robert wants to go to the bank that he always goes to and withdraw some money. This is the first time he uses the queue application to overcome a long waiting time in the bank and he gets a ticket number before he arrives. He needs to launch the program and choose the appropriate steps to reserve a place.

1. Choose language
2. Press “Reservation” icon
3. Tap to “Search”
4. Type the name of the bank, select Country, select City and press “Search” button
5. Press blue button to select the place
6. Choose date department and press “Time Table” button
7. Choose time and press “Get Ticket” button, in pop-up window press “Confirm” button

Action 1:

When he launches the application the first thing he needs to do is to choose a language. The application shows English language as default but provides different languages. Robert knows English and always uses that language for every application. Therefore it is clear for him to choose the language to go to the next screen.

Action 2:

The next step is the main menu. He sees 6 different options. Robert wants to reserve, therefore it is obvious for him to choose exactly that - the “Reservation” button.

Action 3:

As we he wants to reserve a place in the bank, in the next screen he sees that there is no option for bank. However there is a search that he can use to find it. In this stage it is also clear to realize this. But it would be more convenient if he doesn’t have to search for the bank.

Action 4:

In the next step he has to type the name of the bank and choose the country and city where he actually is. He should scroll through countries and cities to choose a specific bank. This stage is not convenient for him to perform these many tedious steps. Then he has to press the “Search” button. The button is small and not in a suitable place for Robert.

Action 5:

After he pressed the “Search” button the new window appears. He typed Barclays and chose United Kingdom and Edinburgh respectively. This screen shows branches of Barclays with their addresses. The font size of the address label is small to see. Due to Robert’s poor technology skills he cannot understand what he needs to press in this step. Then he realises that the blue icon with arrow is for choosing that particular branch.

Action 6:

Now he is going to choose the date and particular department in the bank. It is clear that he needs to scroll up and down to choose the date and for the department part he has to tap department to get different options. Then he presses the “Time Table” button.

Action 7:

The next window is almost the same as before. So it is a familiar screen for him. There is nothing confusing about it. When he scrolls up or down he sees red labels and it is easy to understand that the time is not available. Nevertheless he doesn’t want to get a reservation exactly at each hour. If he needs to reserve a place 13.30 then there is no options to do this. The “Get Ticket” button is clear to comprehend. The pop-up menu is opened and it shows all the information about his reservation. Robert presses the “Confirm” button to confirm his reservation. He also could cancel. The color of buttons are meaningful to distinguish from each other and ensure he does not click wrongly. When he finishes all these steps the screen will jump to the Ticket screen to show his chosen ticket/tickets.

Action Number	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Result
1	✓	✓	✓	✓	Success
2	✓	✓	✓	✓	Success
3	✓	✓	✓	✓	Success
4	✓	x	x	✓	Fail
5	✓	✓	✓	✓	Success
6	✓	✓	✓	✓	Success
7	✓	✓	✓	✓	Success

Task 2 – Robert wants to shop in a supermarket.

Goal: Robert as always every Monday goes to the supermarket which is near his house and does his shopping for a whole week. But there are always long queues in the store. He uses this new queue solution application to get a ticket for the check out and to use that remaining time for buying the rest of the items on his shopping list. Robert uses the map option.

1. Press “Map” icon

2. Tap on the store which he wants to go

3. Press “Confirm” button

4. Choose appropriate queue by tapping blue icon

5. Press the ”Confirm” button

Action 1:

He opens the application. If he used the application before then choosing “language” screen will not appear. It will automatically go to the main screen. He wants to find a supermarket which is nearby. So he uses the map to find it. He presses “Map” icon.

Action 2:

In this part he needs to navigate and find a particular store. It is difficult for him to do this, because it is complicated for Robert. After he finds his place there is a small icon for tapping it.

Action 3:

After that the pop-up window appears which shows the name of the supermarket. This window is obvious and displays the information about the chosen store. The buttons with different colors also are clear. He presses the “Confirm” button.

Action 4:

The list of queues with their remaining times appears in the next window. He presses the small blue icon with the arrow to choose the appropriate service/queue in the supermarket.

Action 5:

The pop-up menu asks whether Robert is sure he wants join the queue or not. He presses the “Confirm” button and gets to the Ticket menu. This step is for him to apply.

Action Number	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Result
1	✓	✓	✓	✓	Success
2	x	x	x	✓	Fail
3	✓	✓	✓	✓	Success
4	✓	✓	✓	✓	Success
5	✓	✓	✓	✓	Success

Task 3 – Robert wants to send a parcel.

Goal: He arrives to the post office to send a parcel to his son. However when he arrives there he sees that there is a long queue. Robert uses the application to scan the QR code which is provided by the post office and to use that remaining time productively rather than standing and waiting. He can see the interactive time to manage his time and work.

1. Press “QR Code” icon

2. Scanning the provided QR Code

3. Press the “Confirm” button

4. View the chosen ticket in the main menu by pressing the “Ticket” button

Action 1:

When he is in the post office he tries to use the QR Code option in the application. It is easy to distinguish it between other options.

Action 2:

The post office provides the QR code for the queue. Robert goes to that place and tries to scan the code. But several times he couldn’t scan it properly.

Action 3:

After scanning the QR code successfully a new window opens and shows information about the ticket. It also displays the remaining time which changes every minute. He presses the “Confirm” button.

Action 4:

Robert sees that the window automatically goes to the Ticket menu to show chosen tickets.

Action Number	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Result
1	✓	✓	✓	✓	Success
2	✓	✓	✓	✓	Success
3	✓	✓	✓	✓	Success
4	✓	✓	✓	✓	Success

Conclusion of evaluation of scenarios based on the experience of elderly person

In task 1 Robert has used the “Reservation” option to perform the task. He wants to reserve a place in the bank. Some of options were clear for him, he does have low level technology skills though. Some of the actions he can’t complete in a short period of time. Also he couldn’t see and understand a part of the windows. Another weakness is that Robert had to go through and choose everything by hand and it took some period of time to do this. Also there was not any clear favorites button to press for saving the particular bank in the favorite list. There is no instruction that he can do it in the settings menu.

In task 2 he firstly becomes confused with the map. As we know it is difficult for him to deal with smartphones. Therefore it was not easy to navigate through a map. But other steps were clear and understandable for him to finish a task. Also there was no favourite button to add it to the favourite list easily.

In task 3 there were a small amount of steps to perform. So this is an advantage for him because he can spend less time getting to grips with the application. The weakness for Robert was that it takes some time to scan QR code properly.

Evaluation of scenarios based on the experience of a businessman

Task 1

Goal: The busy working man, Can Ozonur, wants to send some souvenirs to his partner, he wants to join the queue for the counter, because many people are crowded in front of the self-serve post machine.

1. Open the application
2. Choose the language
3. Choose the QR code mode
4. Press the scan button to scan the QR code after the camera has focused
5. Get a ticket that is assigned by the system, and press the confirm button to accept that ticket
6. The system jumps to the ticket screen where it displayed which ticket he has got

Choosing mode page – Actions 1-3

The first thing is to select the language. He thought this part was fine.

When he enters the application, he sees several buttons on the main menu , he just wants to take a ticket so he presses ticket, but he found nothing in the ticket page. He then realized he was pressing the wrong button. He presses the back button which is on the upper left hand corner of the screen to go back to the previous main menu page. This procedure took about 5 seconds. He chooses the QR code mode.

Getting the ticket – Actions 3-5

He used his phone to scan the QR code which was printed on the desk in the post office. However he does not realize that there is a need for him to press the “scan” button to scan the QR code, because every application which has QR code function he ever used can scan the QR code automatically. Then he realizes maybe he needs to press the button to scan the QR code, because the frame of scanning the QR code just focuses and refocuses the QR code but does not scan it. It took 15 seconds. At that time there is a short queue for scanning the QR code because to scan the QR code typically takes 2—4 seconds. After scanning the QR code the system assign one ticket to him, he just sees the remaining time because that is the only part he concentrated on. There is a blank to separate ticket information and the remaining time, and the remaining time is just in the middle of the dialog box, so he can easily to find the remaining time.

He presses the “confirm” button then the page is redirected to the ticket page. Part of the information of the ticket he got was displayed in the ticket page. He can press the small arrow on the right of the ticket to see more information about this ticket. He can quit the queue or refresh the remaining time manually.

Action number	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Result
1	✓	✓	✓	✓	Success
2	✓	✓	✓	✓	Success
3	x	x	x	✓	Fail
4	x	x	x	✓	Fail
5	✓	✓	✓	✓	Success
6	✓	✓	✓	✓	Success

Task 2

Goal: Can Ozonur wants to join the queue for getting a loan from the bank before he arrives at the bank. When he arrives there, he can do the business immediately.

1. Open the application
2. Choose the map mode
3. Drag the map to Find the bank branch he wanted
4. Press the “confirm” button to go to the category page
5. Choose the queue he wants to join
6. Check the ticket

Actions 1-2

The ticket icon always makes him confused. He thought if he wants to get a ticket for a queue, he will press that button first.

Actions 3-6

He found that there is no search function in the map page, and it has moved to the reservation page, he thought this was very inconvenient.

When he is in the map page, he did not know what he should do, because there is no instruction or help information about how to use this map. He just drags the map, then he suddenly found that the store and branch icon can pop up a dialog box to go to the next step. It takes him almost 20 seconds.

He chooses the queue he wanted and presses the arrow button to pop the dialog box and presses the “confirm” button to confirm to join the queue.

Action number	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Result
1	✓	✓	✓	✓	Success
2	x	✓	x	✓	Fail
3	x	x	x	✓	Fail
4	x	✓	✓	✓	Success
5	✓	✓	✓	✓	Success
6	✓	✓	✓	✓	Success

Task 3

Goal: Can Ozonur wants to make a reservation for a regular health check

1. Open the application
2. Choose the reservation mode
3. Input hospital name
4. Set the country and city then choose the hospital and set some other information
5. Press the “get ticket“ button and then press the “confirm” button
6. Check the ticket

Actions 1-2

The ticket icon always makes him confused. He thought that if he wants to get a ticket for a queue, he will press that button first.

Actions 3-6

The icons except “reservation” on this page make him confused. He did not know the function of other icons, and he felt those icons were unclear for him.

In the category page he got confused as to why the reservation page has lot of categories and a search bar.

He put the name of the hospital into the search bar, then became confused as to why the program did not provide him with a result, but needed him to continue to select the country and city.

He selects the country and the city and then needs to select date and time. Finally he presses the get ticket button. After checking the information on the pop up dialog box, he presses the confirm button.

Action number	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Result
1	✓	✓	✓	✓	Success
2	x	✓	x	✓	Fail
3	x	x	x	✓	Fail
4	x	✓	x	✓	Fail
5	✓	✓	x	✓	Success
6	✓	✓	✓	✓	Success

Conclusion of evaluation of scenarios based on the experience of businessman

In task 1 Ozonur chose the “QR code” mode to perform this task. He wants to join the queue to send a parcel. He thinks the process of scanning QR code should be automatically finished, but not manually. Another drawback of this application is that it should have a page for choosing categories of services after scanning the QR code because he spent some time to find corresponding QR code for different services.

In task 2 Ozonur uses the “map” mode to go through this task. The icons in the main page make him confused. He cannot understand what function the icons performed. There is no information to guide him on how to use this application. In the map page he cannot find any helping information. So he wastes some time in this step. He thinks every page should have some information guide to tell the users how to use this application. Another drawback is that the blue circle button is too small to press. He needs to press twice to do the action.

In task 3, he chose “reservation” mode. The whole process of reservation is complicated for him even if he has some experience for using mobile applications; many navigation actions need to be performed. He does not want to have to put in so much information. He thinks this application is not intelligent enough. A lot of information needing to be set reduces the efficiency of this application, to some extent, increasing the time to join the queue.

Evaluation of scenarios based on the experience of the student

Task1- attending a queue for getting a University ID Card.

Goal: The student, Kieran Walpole, wants to get his new university ID Card. This is his first time to using the queue application.

1. Open the application
2. Choose the reservation mode
3. Choose the University
4. Choose the Country
5. Choose the City
6. Choose Month and Date
7. Choose Department
8. Press Time Table
9. Press Get Ticket
10. Press Confirm

Entering the system- Action 1

He opens the iOS or android application from the smart phone. He chooses reservation mode.

Choosing who he wants to reservation- Action 2 - 8

At first, He does not know anything else about this application. He has never used this application before. He chooses reservation mode. He can use a smart phone very well. He chooses the University from the application then he can go to other part of application easily. To find university he also types from the main screen of the application. The system allows him to type the location. Then he chooses country and city. After that he can see the university on the screen and he chooses the department and time table to get reservation.
He is very familiar with these kind of applications and he is able to follow all of the steps easily.

Getting Ticket- Action 9 – 10

After choosing the date, he goes to the slots and he chooses an available time in the department. Then he is going to press “get ticket” button. He is ready to get reservation. Before getting the ticket, he gets a confirmation part and he confirms his reservation.

Action Number	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Result
1	✓	✓	✓	✓	Success
2	✓	✓	✓	✓	Success
3	✓	✓	✓	✓	Success
4	✓	✓	✓	✓	Success
5	✓	x	x	x	Fail
6	✓	✓	✓	✓	Success
7	✓	x	x	x	Fail
8	✓	✓	✓	✓	Success
9	✓	✓	✓	✓	Success
10	✓	✓	✓	✓	Success

Task2- attending a queue for sending a parcel.

Goal: The student, Kieran Walpole, wants to send a parcel to his friend who is abroad.

1. Open the application
2. Choose the Map mode
3. Choose Locate Self Mode
4. Choose the Post Office
5. Press Confirm

Entering the system- Action 1

He opens the iOS or android application from the smart phone.

Choosing who he wants to reservation- Action 2 - 4

At first, He does not know anything else about this application. He has never used this application before. He chooses Map mode. He finds all branches of Post Office and he chooses the post office from the application, so he confirms an exact post office branch. The system is user friendly and fast. The user does not waste time when looking at the location.

Getting Ticket- Action 5

After choosing the date and which queue. He is ready to get a reservation. Before getting the ticket, he gets a confirmation part and he confirms his reservation.

Action Number	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Result
1	✓	✓	✓	✓	Success
2	✓	✓	✓	✓	Success
3	✓	✓	✓	✓	Success
4	x	x	x	x	Fail
5	✓	✓	✓	✓	Success

Task3- attending a queue for opening a Bank Account.

Goal: The student, Kieran Walpole, wants to open a bank account, this is his first time using the queue application.

1. Open the application
2. Choose the QR Code mode
3. Press Scan
4. Press Confirm

Entering the system- Action 1

He opens the iOS or android application from the smart phone.

Choosing who he wants to reservation- Action 2 - 3

At first, He does not know anything else about this application. He has never used this application before. He goes a bank branch. He chooses QR Code mode and scan. The system is user friendly and fast. User does not waste time when getting a queue ticket.

Getting Ticket- Action 4

After choosing the date and which queue. He is ready to get a reservation. He gets a ticket number confirmation. Before getting the ticket, he gets a confirmation part and he confirms the ticket.

Action Number	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Result
1	✓	✓	✓	✓	Success
2	✓	✓	✓	✓	Success
3	✓	✓	✓	✓	Success
4	✓	✓	✓	✓	Success

Conclusion of evaluation of scenarios based on the experience of student:

Second generation prototypes and their evaluation provides empirical analysis and results. Some results are valuable even though there are a few mistakes on the prototypes which are smart phone applications. There is no blind approach and there are also analytical and fresh approaches on smart phone technology. Queue application finds a common approach for user. So it makes

life easy for user. He, Kieran, showed that he could use these kind of applications at different locations.

User 1

Name: Kieran

User Type: UK Student

Task: Getting a queue number

Observations:

- Found three different icons which are map, reservation, and ticket, those are confusing for him.
- After searching for place he chooses his reservation again. He thinks it may be not necessary.
- He is not sure about the department part. He suggests that it can be another screen of the application.

User 2

Name: Emre

User Type: International Student

Task: Getting a queue number

Observations:

- Found three different icons which are map, reservation, ticket and those are confusing for him.
- He prefers to use map, after searching for the place on the map he gets confused about it.
- He got his reservation number quickly. He is not sure if it is working well or not.
- He suggests that it can have another screen of application.

User 3

Name: Jenny

User Type: Elderly

Task: Getting a queue number

Observations:

- Found three different icons which are map, reservation, ticket and those are confusing for her. She needs to help to understand the program.
- She prefers to use the map, after searching for the place on the map she gets confused about it. She is not sure which one is easiest for her to use.
- She got her reservation number quickly. She is not sure if it is working well or not.
- She suggests that it could have another screen to help the elderly person.

User 4

Name: Can

User Type: Businessman

Task: Getting a queue number to get a loan from the bank

Observations:

- Found three different icons which are map, reservation and ticket and those are confusing for him.
- He prefers to use the reservation part of application, after searching for the place on the reservation he gets confused because there are many steps.
- He could not get his reservation number quickly. He is not sure if it is working well or not. He got confused.
- He suggests that it can have another useful screen of application.
- He said he has never used these kind of systems.

Nielsen Heuristics for Generation 2 prototype			
№	Criteria	Rating	Discussion / ways to solve
1	Visibility of system status	0	The step by step procedure provides clear information, including the ticket number, place, date, time.
2	Match between the system and the real world	1	The procedure of making a reservation with this system is quite time consuming, but some of these situation usually are not able to make a reservation (e.g. getting a student ID card). With this system, it is possible to reduce the queue time people usually needed.
3	User control and freedom	0	There is a “Back” button on every screen, and the tickets can be canceled, so the user can undo whatever he/she has already done.
4	Consistency and standards	N/A	
5	Error prevention	0	Before getting the ticket, the system always pops out a confirmation box to reduce the chance of mis-clicking.
6	Recognition rather than recall	3	The descriptions on the Main screen are not clear enough, “MAP”, “QR code”, “Ticket” the title of these icon are confusing for the user, and it needs to be changed.
7	Flexibility and efficiency of use	3	The efficiency of making reservations. This system needs the user to provide a lot of information for making a reservation, which is too time-consuming. Although there is a “Favorite” in the reservation screen, the system should try to combine the Map mode and QR code mode with the Reservation mode to make reservations a lot easier.
8	Aesthetic and minimalist design	0	The user interface is following an old version of iOS style, it should be accepted by most of the iOS users.
9	Help users recognize, diagnose, and recover from errors	0	Same as No. 3, the user can see if they have made an error before tap on the confirm button. And they can delete the ticket if they want to reschedule or just cancel the reservation or queue.
10	Help and documentation	0	There is a help function in the main screen, so the user should be able to learn how to use this system quickly.

Conclusion of Second Generation Prototype

Based on the design and analysis of three first generation prototypes, the second generation prototype was born. The three first generation prototypes cannot meet the requirements of adapting to the diverse and complex real world situation. The second generation of prototype absorbs the advantages of three first generation prototypes, and corrects the weaknesses of them. Different from the first generation of prototype design tool (Balsamiq Mockups), the Pencil Project was used to design the second generation prototype. The Pencil Project has a unified interface style and it involves a lot of material about IOS themes compared with Balsamiq Mockups, and it is easy to get started on. Several problems in the second generation prototype were revealed via Cognitive Walkthrough and the Heuristics evaluation. The second generation prototype has three main functions for three specific situations. Map mode so that the user can join the queue from a medium distance to the destination. When the user wants to join a queue through the map, because it is the medium distance, users can have good control over their own queue time, and continuously updating the remaining time will remind users when they should stay in the queue. But this model is not perfect, in some cases, it cannot achieve the desired effect, for example, the application does not fully use the location function of a mobile phone, to some extent, which increased the time that users took to join the queue. That is to say, the program is not as "smart" as expected. QR code mode is suitable for the user who is already in the place where they will join the queue, and it is the fastest the way to join the queue among the three modes. But this mode still has some shortcomings. The manual scanning button greatly reduces the efficiency of this model. Therefore it should be replaced by an automatic scan. In addition, there may be another queue of users who want to scan the QR code. So this mode to some extent is also not very efficient. In reservation mode, some problems appear in the first generation model which have not been completely solved, for example, the reservation process is too complicated. Too much information needs to be entered. The user experience is very poor for this reason. In terms of overall application, the possibly confusing main menu interface is the biggest problem our evaluation showed. Almost all the users and personas have the same problem that the names and icons of the three modes make them confused. They cannot directly understand the function of the mode through the name and icon. The only way to know the function of each mode is to try to use them. That is another flaw which results in poor user experience.

Recommendation

In order to make sure the application can be used more efficiently in the real world, a series of problems need to be addressed.

The location functions of the Mobile phone need to be fully used by this application. The purpose is that the program can be more intelligent in dealing with the information of the user's location and can smartly indicate a queue that users may want to join.

The searching box also need to add an association input function, that means that the application can intelligently detect the text that users want to input when the user inputs only one or a few letters, and will show the results in one drop-down list for the user to choose.

Each interface should be more friendly during interaction, for example, in the first time the user using this application, a tutorial animation can be used to teach users the function of each mode, which can help to improve the speed of the user who is now familiar with the application. At each interface there should be a tip to help the user when they encounter a problem in the application.

The application should be designed for different groups of people and should have smooth switching between the various interfaces. The second generation prototype cannot satisfy the needs of elderly users well. Mainly because the size of button and the word is too small for elderly users, one interface for elderly users should be added in the next generation and switching between this interface and normal interface should be convenient.

In terms of user interface, most of the manipulation in the second generation prototype is the click. It is not suitable for the trend of the increasing size of phone's screens. With the increasing size of mobile phone screen, sliding operation becomes more popular. For example, two fingers gesture slide to left or right can be used in the operation of switching mode.

CONCLUSION

This project aimed to create a new approach to the problem with the existing queue management systems. Our project was about a queue mobile application. There are no such systems which take on this problem and realize it can be solved on smartphones. Therefore, we analyzed the definition of the problem and an evaluation of existing systems, and then we evaluated three different personas with three distinctive scenarios. After this part of the project we created three 1st generation prototypes and the last high fidelity prototype which consolidated the problems from the low fidelity models.

In the first stage we investigated the definition of the problem. The problem was that there wasn’t any efficient interactive queue mobile application in the market. We decided to overcome this issue and create an application for smartphones to manage time within queues.

After we defined the subject we began to analyze the existing systems in the world. Therefore, we determined the general public opinion of queue management systems, their weaknesses and

strengths. We focused on weaknesses and tried to eliminate the problems. Also we utilized the strong points of other systems and implemented them in our project.

Before presenting the first generation prototype we worked on three different personas to understand the usability of the application. Personas were from different ages, status and had different technology skills. Moreover, we studied three scenarios for each persona to engage with the usage of the application by people in various situations.

Subsequently, we started to prepare the first generation prototype. We accomplished three low fidelity prototypes and added diverse options to each of them. The tool we used was mockup. The prototypes were evaluated based on the experience of personas. Then we used Nielsen's Heuristics method to evaluate our prototypes. The analysis of this helped us to generate our next step for the application.

The last part of our project was the designing of a second generation prototype. It is inspired by the first prototype and established a new one by using different aspects of it. We examined the weaknesses of the first prototype and utilized several functions to build new prototypes. We used the "Pencil" tool. Additionally, we evaluated this prototype as well. We used Neilson's Heuristics and cognitive walkthrough methods to estimate the functionality of this prototype.

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